FLIGHT and The AIRCRAFT ENGINEER

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The Outlook

Direct or Indirect Cooling?

DURING the first years of its evolution the air-cooled aero engine struggled against many difficulties. It gradually overcame most of its early teething troubles, and its low specific weight and general simplicity were always points in its favour. For some years the problem of cooling was imperfectly understood, and it cannot be denied that both on the score of form drag and that of cooling drag the air-cooled engine showed up to disadvantage. Then came the Townend ring, a sort of Handley-Page circular slat, which kept the ex berance of the air flow somewhat in check. This cowling ring did much to give the radial air-cooled a new lease of life. In America the N.A.C.A. evolved the long-chord cowling, and the system of baffles.

In the meantime, research in England led to an appreciation of the possibilities of low-drag liquid cooling, and a Farnborough technician, Mr. Meredith, called attention to the ability of so-called ducted cooling to reduce drag, and even to convert it into a positive thrust. It was natural that this discovery, plus the known low form drag of the liquid-cooled engine, should stimulate the development of that class of engine. How well it succeeded is shown by the speeds obtained by such British fighters as the Hurricane and Spitfire.

The United States, on the other hand, to all intents and purposes dropped the liquid-cooled engine, with the result that to-day America has but a single high-power engine of this type, the Allison. But she did pursue a vigorous research policy, and recently the N.A.C.A. appears to have evolved a system of ducting and cowling of radial air-cooled engines which brings the drag down to that of the liquid-cooled of the same power. Thus our cousins on the other side claim to have caught up with us in air cooling against our liquid cooling, or, as we would rather express it, direct cooling against indirect cooling, for both forms are air cooling in the end.

Some American Views

LITTLE has been heard of the details—ways and means—of this American research, but in a paper presented to the Engineers' Club of Philadelphia at the end of last year Mr. J. C. Hunsaker, of the Massachusetts Institute of Technology, world-famous as the M.I.T., referred in no uncertain terms to the benefits that have accrued from the results of the N.A.C.A. research. "In its Langley Field wind tunnel," Mr. Hunsaker said, "the National Advisory Committee has developed means of streamlining (ducting and cowling) the American radial air-cooled engine so that its drag can be made as low as that of the best liquid-cooled engine installation. Thus, recent technical progress has enabled American airplane builders to demonstrate airplanes with larger air-cooled engines at speeds exceeding 400 m.p.h. There now appears to be nothing to choose, as to speed, between the two types of engine when each is properly installed. This statement could have been true several years ago, but the results of research were available only recently."

About a month after Jerome Hunsaker's paper, the assistant director of research of the United Aircraft Corporation presented a paper to the Airplane Design Section of the Institute of the Aeronautical Sciences (the American equivalent of our Royal Aeronautical Society) on the subject of air-cooled versus liquid-cooled engines. The first part of that paper is published in *Flight* this week. Mr. Lee finds that the air-cooled is slightly better than the liquid-cooled engine on fuel consumption at cruising speed, although at full throttle the latter is more economical. He also refers to the N.A.C.A. low-drag cowling, and having demonstrated, to his own satisfaction at least, the equality of the two classes in the matter of cooling drag and fuel consumption, proceeds to set off the low form drag of the liquid-cooled against the low specific weight of the air-cooled. He finds that on

aircraft of equal size and weight the air-cooled can accommodate the more powerful engine, plus the extra fuel which the extra power requires.

Mr. Lee does not fail to point out that an important corollary is that the air-cooled aircraft, with its greater power, will have a shorter take-off and a better rate of climb than the liquid-cooled, and asserts that these properties are often of equal military importance with speed.

Off on the Wrong Leg

MR. HUNSAKER expresses—or rather infers that he feels—mild annoyance with the side-tracking into which early British liquid-cooled research has led the American authorities. "We now have the interesting situation," he says, "of a very large production programme for 1,200 h.p. fighter airplanes based on European-type liquid-cooled engines, which is getting well under way at about the time our own engineers present us with two 2,000 h.p. engines, and our scientists show us how to streamline them in an airplane installation to secure extremely high speed."

We would suggest that Mr. Hunsaker take comfort from the fact that the history of flying has been full of such "false scents." There are even those who hold that if Wilbur and Orville Wright had not produced their biplane until a few years later, the helicopter would have come in for the intensive development that was later bestowed upon the aeroplane in such rich measure.

And, anyway, it is not too late to apply this new knowledge to aircraft using the latest form of cooling and cowling. Whatever mass production America and England may achieve between them, it will still be necessary to plan and work for the longer policy which will give America the chance, as Mr. Hunsaker puts it, to use that "potential ability to make obsolete all fighter airplanes in the world to-day, including our own." The war will not be over just yet, and if American aircraft designers cannot make use of the N.A.C.A. engine streamlining, British designers can and will. America, as the arsenal of democracy, must produce the quantities. England could well undertake experimental and development work.

In the meantime, we still have to be convinced that the liquid-cooled engine has been made obsolete by the recent American developments. We in this country are not limited to 1,200 "liquid-cooled horses."

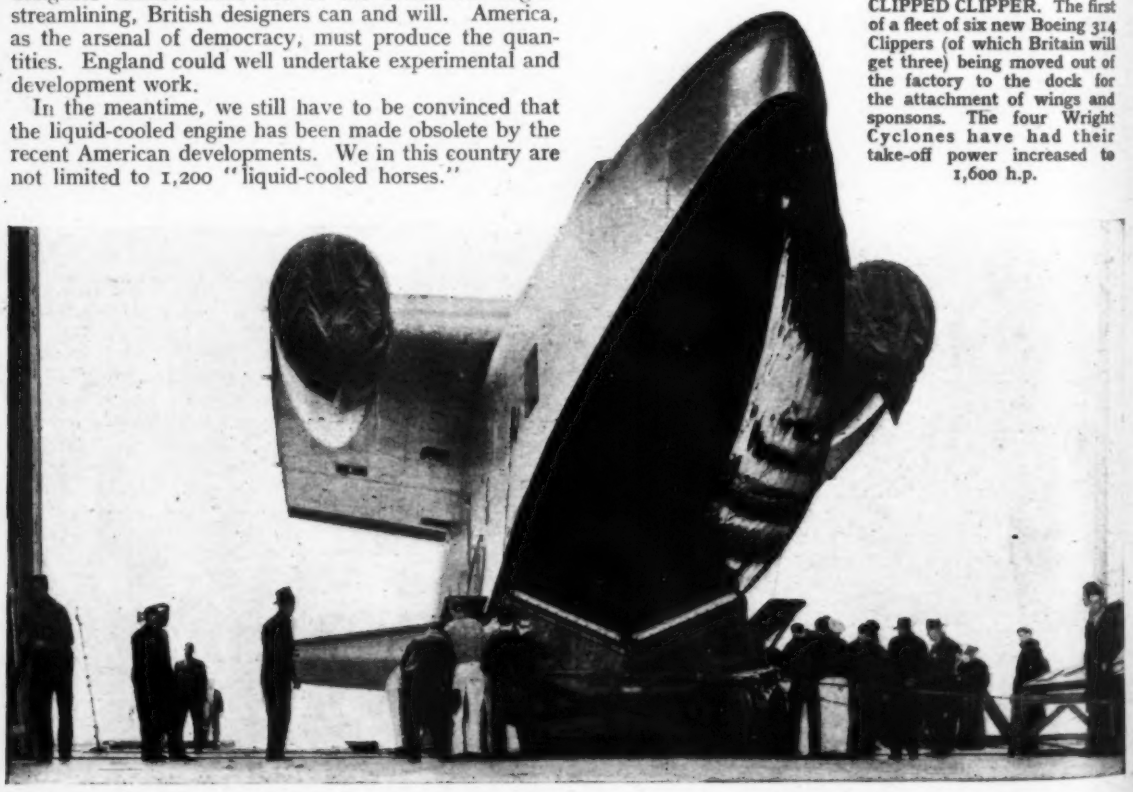
". . . So Many to so Few"

MR. HUNSAKER will understand that we cannot give "chapter and verse" for the statement, but we can assure him that he is not correct when he states, after mentioning the two American air-cooled engines of 2,000 h.p., that "nowhere else in the world are engines of such power available." For obvious reasons we must refrain from being more explicit than that.

But apart from Mr. Hunsaker's very natural pride in the achievements of his country, one does feel that he is a little unfair to the liquid-cooled engine when he says: "The case for the liquid-cooled engine seemed to be very convincing. Yet it was based on a false conception of the aerodynamics of the matter. There was also an element of propaganda in it."

We would like to point out to him that the liquid-cooled engine, whether by false conception or propaganda or both, did enable Great Britain to stave off what looked at one time like inevitable defeat. If it had not been for the Hurricanes and Spitfires, the "Blitz" on London last year might well have succeeded. As it was, the Rolls-Royce Merlin gave those fighters the power to sail into the Germans and scatter their huge formations. We wish Mr. Hunsaker could have seen a squadron of them, as we saw it, wade into the Germans head-on. Jerry could not take it, and his formation broke up precipitately.

It is not too much to say that England was saved in those days by the Merlin, and Mr. Hunsaker might remember that the N.A.C.A. had not evolved its new ducting and cowling at the time that little liquid-cooled engine went into production. So we would couple with Mr. Churchill's historic phrase our indebtedness to one liquid-cooled British engine.



CLIPPED CLIPPER. The first of a fleet of six new Boeing 314 Clippers (of which Britain will get three) being moved out of the factory to the dock for the attachment of wings and sponsons. The four Wright Cyclones have had their take-off power increased to 1,600 h.p.

War in the Air

LONGMORE'S PERSUADERS : Three Vickers Wellington IAs in Vic over the Western Desert.

German Blockade Tactics : Night Fighters : Sunderlands' Good Work

GERMAN air policy in the latter part of February and the opening days of March had the appearance of being designed to assist Hitler's blockade policy. For a period there were no attacks of any consequence on London, but a series of heavy raids on Swansea was succeeded by similar attacks on Cardiff. As is usual in German raids, there was much destruction of private property and such buildings as churches and schools, but it may be guessed that the object of the raids was to interfere with port facilities. At the same time there has been a certain amount of mine-laying by aircraft off our coasts, while, above all, there is the vigorous attack by air and submarine on the shipping in our western approaches. Weather may to some extent have governed the operations of the Germans, for it has been patchy, and sometimes it may have happened that only the formations operating from the neighbourhood of Brest against the west of Great Britain were able to send off any considerable number of machines, while those which normally deal with London only despatched a few individual bombers flown by expert pilots. All the same, it does look as if the chief rôle of the *Luftwaffe* during the recent period has been to back up the policy of blockading Great Britain.

If this is a reasonable conclusion, it also suggests that, as Hitler has had his hand forced by the Greeks and General Wavell into starting a land campaign in the Balkans, he does not intend to embark at once on an invasion of Great Britain. The majority of his heavy bombers are still ranged up in Northern France, though at times some units are moved back, perhaps into Germany, to rest and refit; but it is not at all likely that a large German Army will undertake a major campaign in the North while there is also a major campaign in progress in the Balkans. It would be unwise to feel too sure about such a theory, for the Germans certainly have large numbers at their disposal, and the concentration of troops in Rumania and Bulgaria is not estimated as very great; but the known German dislike for fighting on two fronts at once suggests a postponement of the attempt to invade Britain. It may be that the German General Staff has advised Hitler that such an attempt at present would have little prospect of success, and that it would be wiser to try to break British spirit first by cutting down her imports. In the meantime, the opportunity could be seized of dealing with Greece, limiting the growing British mastery of the Mediterranean, and helping Italy. If that is to be done at all, it is important that it should be done quickly before General Wavell completes his conquest of East Africa, and so sets free his whole Army for use in other directions.

Hitler has the tactical initiative, in that he is free to choose (or, rather, his Generals are) the route by which he will march through Bulgaria to attack Greece, but he has lost the strategic initiative because he has been obliged to go to the help of Italy whether he wanted to move in that direction just now or not. But he has not sent very large air contingents to that theatre. It is reckoned that there are not more than 500 to 600 German machines in Bulgaria, with a large percentage of them Me 109s, but not many long-range bombers. In Sicily there may be 300 to 400 German aircraft, many of them of the Ju 87 type, with some Me 110s, some reconnaissance machines, and a certain number of troop-carriers. The number of aircraft congregated in Bulgaria is limited by the number of aerodromes in that country, which is small. The Germans may in time prepare more.

Another form of German air activity of late has been raids by single bombers on aerodromes in East Anglia. Cloudy days are almost a necessity for that sort of raiding, as in a clear sky the bombers would have little chance of escaping if sighted by the British fighter patrols.

The R.A.F. at home has been showing increased activity of late, and daylight sweeps over Northern France have been getting more common. There was one very spirited raid by daylight on Boulogne, covered by fighter screens. One fighter formation operated over the Channel and a dogfight at 30,000ft. with Me 109s ensued. One of the latter was seen to dive into the Channel, unable to pull out of a dive, though the pursuing

WAR IN THE AIR (Continued)

LANDED IN PORTUGAL : The end of a Focke-Wulf Kurier shipping raider whose navigator's slide rule slipped.

Spitfire had not even fired at it. The squadron to which the Spitfire belonged believed that it had destroyed five more of the enemy and damaged another. On the day's work three of our fighters were lost, but the way was evidently opened for our bombers to reach Boulogne, where they scored hits on the docks and started a large fire in the inner harbour.

Interesting things have also been happening at nights. The A.A. guns have been taking toll of the German raiders to an increasing extent, and our night fighters have also had some very gratifying successes. In particular they have been visiting aerodromes in France and waiting for bombers to return from their raids on Britain. One night a British fighter pilot visited two different aerodromes and claimed a probable victim at each.

At the first enemy aerodrome he visited he found a machine about to land and gave it two full bursts from his guns from very short range. Then, as he passed over the machine, he let go a stick of bombs from only 200 feet and saw them burst directly in the path of the enemy plane as it was taxying along the ground. "It must have received the full force of the explosion," said the pilot. Guns around the aerodrome then came into action and made it an unhealthy spot to remain in, so the pilot set off to find other prey. He soon found what he was looking for—another unsuspecting German returning to his base. Again the pilot closed and poured a long burst from his front gun into his victim. The German turned sharply away, but in doing so gave the rear gunner a chance. He had time to get in two long bursts which appeared to go straight home. The enemy landed hurriedly and appeared to crash.

Our night fighters over this country were active, too, on the same night, and damaged in combat a Ju. 88 and an He. 111. Both machines appeared to be in such trouble that if it had been daylight our patrols would probably have seen them crash. The pilot who came across the Heinkel stalked it until he was only 30 yards away, and then let fly with all he had got. Just before the night fighter lost contact with the Heinkel he saw a bright white flash come from it. It was a Squadron Leader who encountered the Ju. 88 and, from 200 yards, saw his shots registering all along the fuselage.

On another night a pilot who carried out an offensive patrol over an enemy bomber aerodrome during the night reports that he saw a German bomber preparing to land and immediately gave chase, following it round on its circuit and firing from close range. The ground defences opened up against our fighter, but had to cease fire on a signal from the enemy plane, which was in danger of being shot down by German guns. The enemy turned away but could not escape the fighter which closed in to attack. During this attack the bomber was recognised as an He. 111, and, after another burst from the British fighter, it fell away rapidly and was not seen again. The fighter pilot's report says: "It is unlikely that this machine could have recovered from such a violent sideslip at that low altitude."

German night-fighters have also been more active of late, and our bombers have fights with them every now and then. One night a British bomber over Cologne was first hit by *Flak* and then attacked by a German fighter. The bomber had successfully bombed its target on the first run; another run was then made and incendiaries started small fires. As the bomber turned for home, a shell-burst damaged the starboard wing. The bomber went into a dive, but the captain managed to pull it out at about 6,000 feet. At this height the bomber was caught and held in many searchlights, and because of the damage the pilot was unable to take much avoiding action. There was nothing for it but to come lower and fire at the searchlights. By this time about 40 searchlights were centred on the aircraft, so the rear-gunner decided to pick off those in the largest groups. He opened fire with short bursts and the beams went out, one after another.

Now a new danger threatened. What had first appeared to be a particularly brilliant searchlight was recognised as the beam of an enemy fighter's headlights. At 200 yards the rear-gunner gave the enemy a preliminary burst. He then held the fighter in his sights and opened fire again. He kept up a continuous fire, and, as he put it: "I saw my bullets going straight into the enemy at about 30 yards." The enemy plane burst into flames and dived steeply. The observer in the front cockpit of the bomber caught sight of it and watched the flames. No reply had been made by the enemy fighter and the rear-gunner who shot it down believes that the German had intended to attack from above but had been caught by surprise. With the target bombed and the enemy fighter disposed of, the bomber crew continued home and landed safely.

Of late the Coastal Command has not had much limelight on its proceedings, but its work goes on without intermission, and in the winter it is more exacting than ever. Navigators of Sunderland flying boats passed a severe test, with honours, when for three days they provided escort to a damaged merchant vessel which had been disabled by enemy action and was drifting 300 miles west of the Shetlands in the worst Atlantic winter weather. The crew of a Sunderland received the position of the merchant vessel and instructions to find her. Visibility at sea was never more than

WAR IN THE AIR (Continued)

ENEMY AIR LOSSES TO MARCH 8th

	Over G.B	Over Europe	Middle East
March 2	1	—	2
" 3	3	1	5
" 4	3	1	9
" 5	1	—	17
" 6	1	—	—
" 7	—	—	—
" 8	2	—	—
	11	2	33

Total in Northern Area, 4,266; Middle East, about 1,125.

two miles, with the clouds down almost to the water at times, and a gale making it extremely difficult to steer an accurate course. But the pilot succeeded, aided by skilful navigation. After two hours flying he found himself right over the crippled ship. It was raining almost continuously, and the Sunderland had difficulty in keeping the ship in sight, but signalled to her that other ships were coming to her assistance. After staying with the merchantman as long as fuel allowed the Sunderland started for home. On its return journey it flew over a convoy which had been ploughing through mist and rain for days, with never a glimpse of sun or star from which to get a position. As the aircraft appeared, the leading ship signalled: "Where am I?" The Sunderland was able to supply the answer. Although the same bad weather continued for the next few days every Sunderland sent to escort the crippled ship on its way to port succeeded in finding her.

In Africa

AFTER the capture of Benghazi there ensued a period of no news from Libya. Perhaps there may be some before these words are printed, but in the meantime one may suppose that General Wavell, after consultations with Mr. Eden and General Sir John Dill, has decided that Tripoli may well wait for a while. The Germans have managed to land some troops there, but they are not likely to be numerous enough to make any difference to the general position. There is no longer any chance of an enemy invasion of Egypt. Of course, it would be very gratifying to carry the Allied banners up to the frontiers of Tunisia, and to display them to the French forces in that Colony. But that can wait for a more convenient time. The urgent matter just now is to reinforce the Greeks against a German attack from Bulgaria. A while ago it was officially denied that British land forces had disembarked at Salonika, but that does not prove that the Germans will not find British bayonets confronting them when they advance towards the Aegean Sea. Hitherto our help to Greece has been in the air and on the sea, for on land the Greeks were well able to deal with the Italian forces. But a German Army on their flank is a different matter and will require different dispositions. Some of the passes through which the Germans must advance give great scope for vigorous bombing attacks. During the last war British bombers pretty well wiped out one Bulgarian Army as it tried to retreat through the mountain passes. If Blenheims and Hurricanes get to work in that way, the Me 109s will have a busy time trying to protect the German advance.

Incidentally, it is very pleasing to know that the Italian bombers who committed the crowning outrage of bombing Larissa after the earthquake mostly paid the penalty for their crime. One formation of five was completely wiped out, four being shot down by fighters near Larissa, while the fifth went into the sea near Preveza. The crew of the latter was taken prisoner. Another formation, equally criminal, met British fighters as they neared Corfu on their way home, and three Italians were shot down.

Raiding on Malta has been spasmodic. That fortress is well able to hit back. On one recent day over 100 Italian and German machines took part in a raid on the island. As a result they lost 16.

BRITISH AIR LOSSES TO MARCH 8.

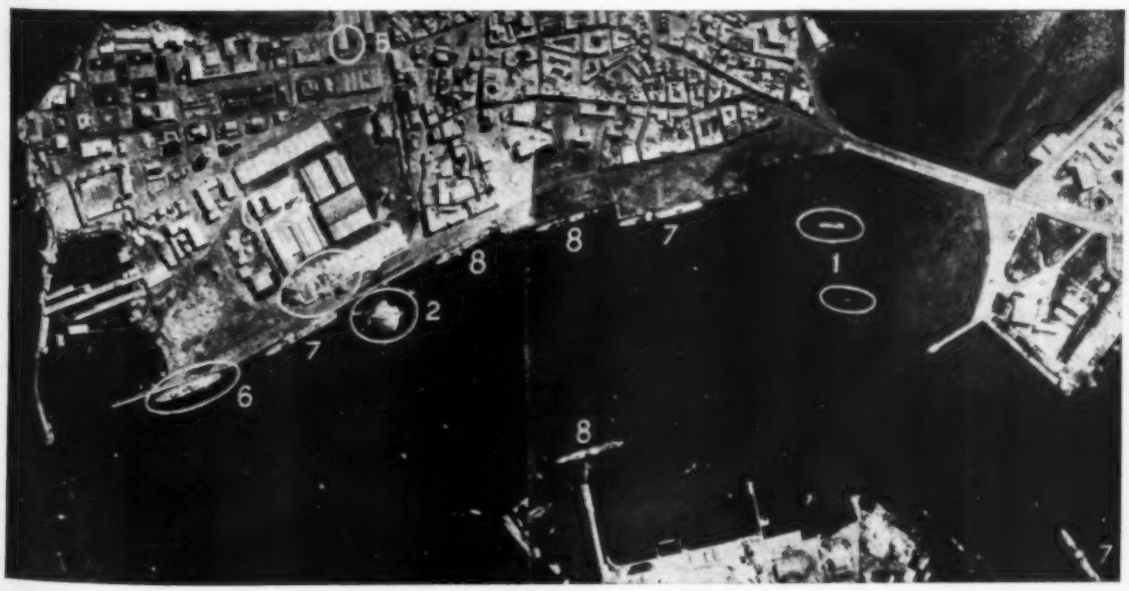
	Over G.B. Aircraft	Over G.B. Pilots	Over Europe Aircraft	Middle East Aircraft
March 2	—	—	5	1
" 3	1	1	2	—
" 4	—	—	—	2
" 5	—	—	3	—
" 6	—	—	—	—
" 7	—	—	—	1
" 8	—	—	—	—
	1	1	10	4

Total in Northern Area, 1,764; in Middle East, 121.

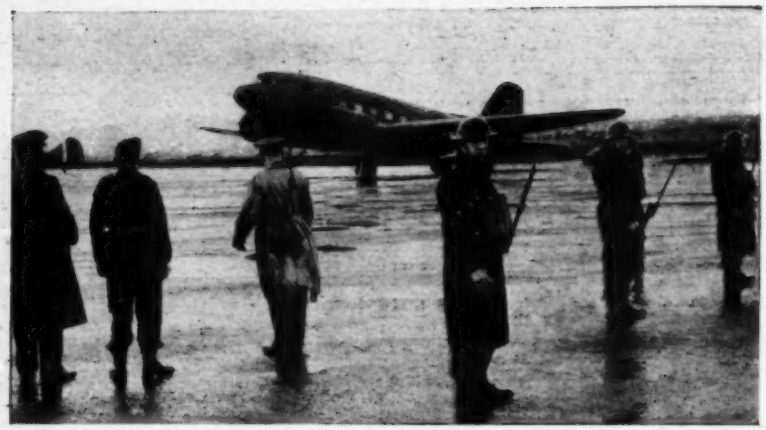
London Bombed Again

WHILE the German tactics against Great Britain, as was stated above, seem in general to be based on helping their so-called blockade, their bombers occasionally break out and have what they probably consider a treat by scattering some bombs aimlessly over London. A clear spell of weather last week-end evidently tempted them to depart from their regular tactics (of which the object is understandable and can be appreciated) and to indulge their native lust for murder and destruction. The raids were heavy, and a good many people were killed. Londoners have not petitioned Mr. Churchill to sue for peace on Nazi terms. Do the Germans still hope that they will?

The "Lease and Lend Bill" has been passed by the U.S.A. Senate, and nothing now hinders President Roosevelt from sending Great Britain all the aircraft and other arms available.



ERITREAN EXPOSURE: An interesting vertical photograph taken during an air raid on Massawa. The points of interest are:—
1. Bombs falling towards the target. 2. Direct hit on a ship. 3. Direct hit on a long shed on a quay
4. Shed badly damaged. 5. Building completely demolished. 6. Sloop.
7. Three destroyers of the Leone class. 8. Three destroyers of the Sauro class.



DIPLOMACY BY AIR : Ever since flying became a means of transport, its speed has made it essential for the use of diplomats. Mr. John G. Winant, the newly appointed American ambassador, and his legal adviser, Mr. Benjamin Cohen, flew by Clipper to Lisbon and thence to England in this Douglas DC-3.

Bomber Parts from General Motors

IT is reported from U.S.A. that the Fisher Body factory of General Motors will be used to make sub-assemblies of the North American B-25 bomber. The parts will be assembled at a new factory to be built for North American at Kansas City.

Germany in South America

THE Germans are not asleep about South America and are apparently pushing ahead with their aviation plans in that country, for the German steamer Lech (3,290 tons) which sailed across the South Atlantic from Bordeaux and arrived at Rio de Janeiro on March 2, after a voyage of 31 days, carried a cargo of civil aircraft. These are intended for use on the Syndicato Condor airlines, a German company which operated a fleet of Junkers between Natal, Rio de Janeiro, Montevideo, Buenos Aires, Lima and other towns.

Flat Air-cooled Six

THE Franklin 6-cylinder, horizontally-opposed, air-cooled engines are described in a recent issue of *Aero Digest*. They are built in two ratings, differing in stroke. One is rated at 117-120 h.p. at 2,600 r.p.m., and the other gives 130 h.p. at 2,550 r.p.m. They are built to operate at considerably higher speeds with the idea of being geared to deliver increased outputs, the larger one developing approximately 164 h.p. at 3,500 r.p.m. "Motor car" starting is provided.

TEA UP, CHAPS! There are few things more welcome than a "nice, hot cup of tea" on a cold day, and the R.A.F bomber crews have reason to thank the Y.M.C.A. whose mobile tea cars greet them on their return from a "show" and supply "the cup that cheers" as soon as they step out of the aircraft. In the picture is Lord Fermoy, personal friend of the King, who drives one of these tea cars every day to a Coastal Command station, having a quick one with the Wing Commander. Lady Fermoy shares in the work and hands out tea to appreciative Hudson crews. Incidentally, the Y.M.C.A. lost 24 of these cars and their equipment to the value of some £70,000 during the evacuation from France, so financial help will be gratefully received.

An Early Radio Beam

IT is not generally known that a radio beam was in use as early as 1927 and that it was an automobile company which developed the device. In 1924 the Ford Motor Company announced its intention to enter the field of aviation and by 1925 it was running an airline with its tri-motored all-metal monoplanes. By 1927 Ford engineers had perfected a radio beam working on the now familiar overlapping signal principle to such a pitch that a return flight was made, directed by the beam, from Dearborn to McCook Field, Dayton. During these years the U.S. Army Air Service was also working on the problem and had its own design of beam.

THE PAPER PROBLEM

THE widespread demand for *Flight* has inevitably led to disappointment among those unable to purchase their weekly copies. Due to the paper situation casual sales ceased long ago, and publishers of journals have been obliged to limit circulations. Again, therefore, we would impress upon readers the vital necessity of placing a definite order for copies and better still to arrange to share a copy with friends. Many copies of *Flight* are already passing through half a dozen different hands.

HERE AND THERE

Air France to Operate Again

RE-ESTABLISHMENT in London of the French airline "Air-France" is expected to be announced shortly. According to the *Financial News*, certain services in the western hemisphere will be restarted with the use of part of the fleet of aircraft which escaped from France at the time of collapse. Later it is hoped to restore lines between South America, Africa and Europe.

This statement was followed by an announcement in *The Times* that Argentina had authorised establishment by the Italian Trans-Continental Airlines Co. of a commercial air service between Rome and Buenos Aires by way of the African coast, Brazil and Uruguay, it being stipulated that 80 per cent. of its Argentina staff must be of Argentine nationality and the air crews either Argentine or Italian civilians.

Confidence

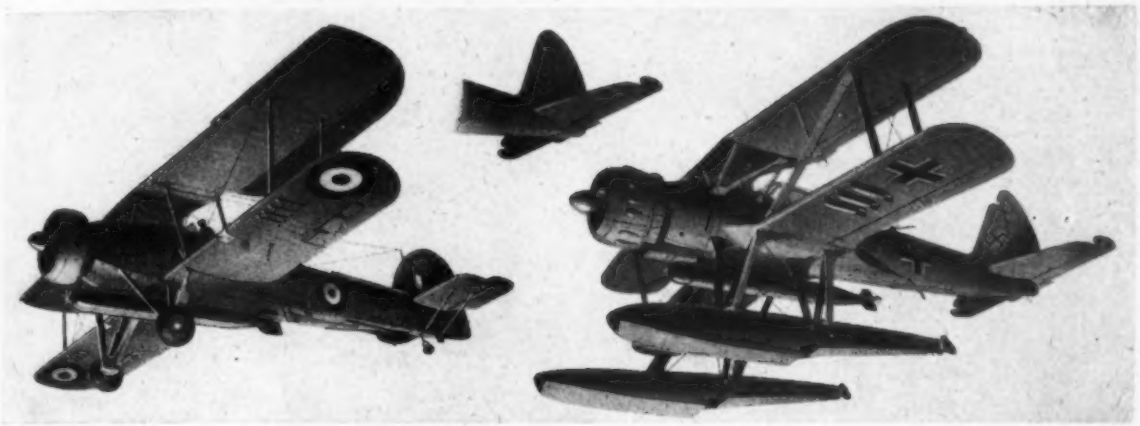
HERE is a little story from Cyrenaica which shows, once again, what confidence the people of other nations have in the final triumph of British arms. It was told by an R.A.F. officer who, during a terrific storm, was given a night's shelter in a priest's home.

Next morning the priest handed him a letter addressed to his mother in Rome with the request that the officer should deliver it when the R.A.F. entered the Italian capital.

Tenth of the Series

FRIEND or FOE?

Opposing Biplanes on T.S.R. Duties : Easily Identified Rivals



Fairey Swordfish. Staggered wings, the top being backswept and the bottom one straight and of smaller area. Radial engine. Long fuselage with open cockpits. Large fin and rudder. Elevators project beyond tailplane tips.

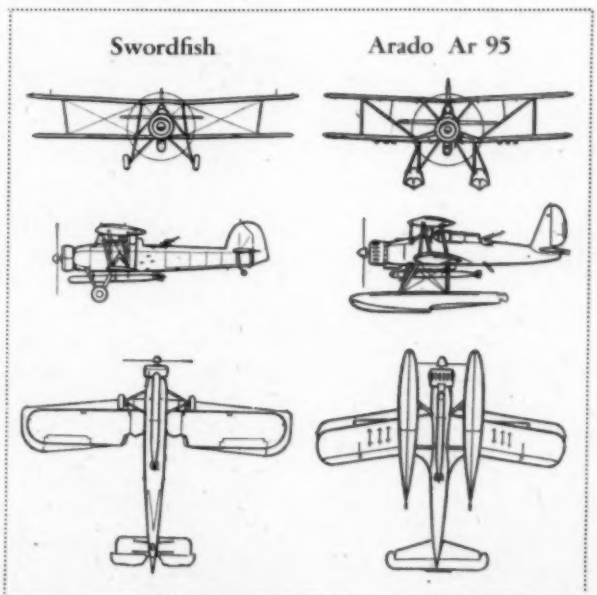
Arado Ar 95. Staggered backswept wings of equal size, the bottom one being slightly cranked. Radial engine. Fuselage with covered cockpits carried on floats. Rudder projects above fin ; one-piece elevator across width of triangular tailplane.

RECENT successes scored by Fairey Swordfish operating with the Fleet Air Arm, principally in the Near East, have brought the name of this machine prominently before the public, and although it is an obsolescent type, it is still used in large numbers and with telling effect, particularly as a torpedo carrier operating against enemy ships. Its German opposite, from the point of view both of design and operational duties, is the Arado Ar 95 float-plane, which, however, has not been used to any great extent, as yet, by the Luftwaffe. When the Germans seek to increase their activities, however, this and other obsolescent types of aircraft may well become a more familiar sight.

Since the Swordfish operates from aircraft carriers and normally has a wheel undercarriage, one might assume that it can at once be recognised from the Ar 95 float-plane. But it must be remembered that floats can, and might at any time be fitted to the British machine, while the substitution of wheels for floats on the Arado is by no means unusual. This normal difference, therefore, while indicating the probable identity of an approaching single-bay biplane in the vicinity of sea operations, should not be relied upon as an infallible proof of nationality.

Differences in wing formation will be readily noted from any angle of approach, as a moment's study of the accompanying pictures and small sketch-plans will show. From the head-on view the Swordfish will be seen to have a greater dihedral angle to its top wing than its lower one, while the Ar 95 will be instantly recognised by the fact that its lower wing is cranked. The arrangement of the inter-plane struts also differs considerably, and, from any but a direct, head-on view, the equal back-sweep and area of both pairs of wings on the German machine will be readily observable. This is in contrast to the unusual wing design of the Swordfish, on which the top wings only are backswept and are of greater area than the bottom ones.

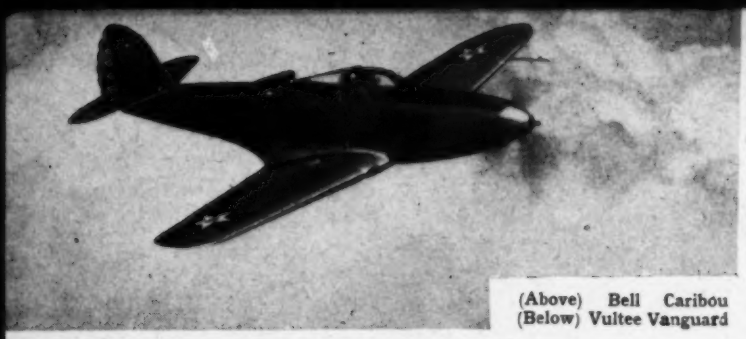
The plain cowling of the Fairey's radial engine is of greater diameter than the tapering section of the nose of the fuselage, but the Arado has a "helmeted" cowling faired into the fuselage. The Swordfish has open cockpits but the Ar 95 has its cockpits covered. The British aircraft has a large fin and rudder but its elevators project beyond the tips of its rectangular tailplane. On the German machine the tall fin and rudder may be of normal design or the rudder may project above the fin in a sort of curl. The tailplane is triangular and the elevator, which projects well aft, forms an unbroken surface across its entire width and is extended round the tailplane tips.



When used for torpedo-dropping, each machine carries its "tin fish" under the fuselage, and its protective armament consists of at least two machine-guns, one fixed, synchronised gun firing through the airscrew disc and one free gun mounted in the rear cockpit. Additionally, each machine can carry three or more bombs beneath each lower wing.

Types previously compared: (1) Hurricane and Me 109. (2) Spitfire and He 113. (3) Beaufort and Ju 88. (4) Lysander and Hs 126. (5) Hudson and Me 110. (6) Anson and Fw 186. (7) Hereford and Do 215. (8) Blenheim IV and He 111k. (9) Skua and Ju 87.

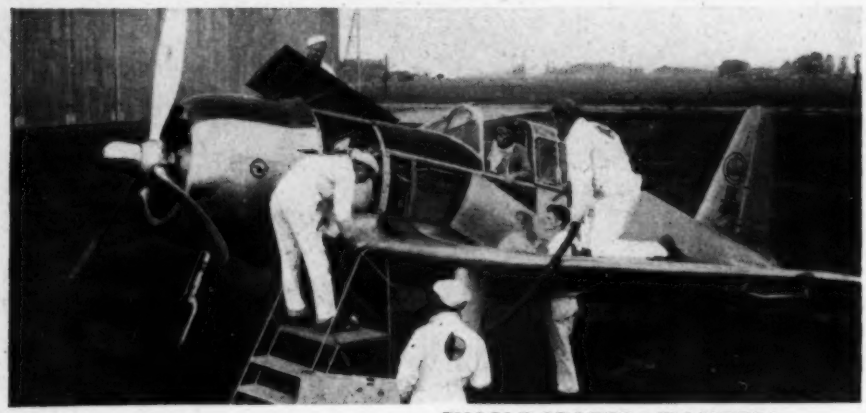
Next week: Sunderland and Do 26.



(Above) Bell Caribou
(Below) Vultee Vanguard

. . . BY ANY OTHER

Photographs and Simplified American Types

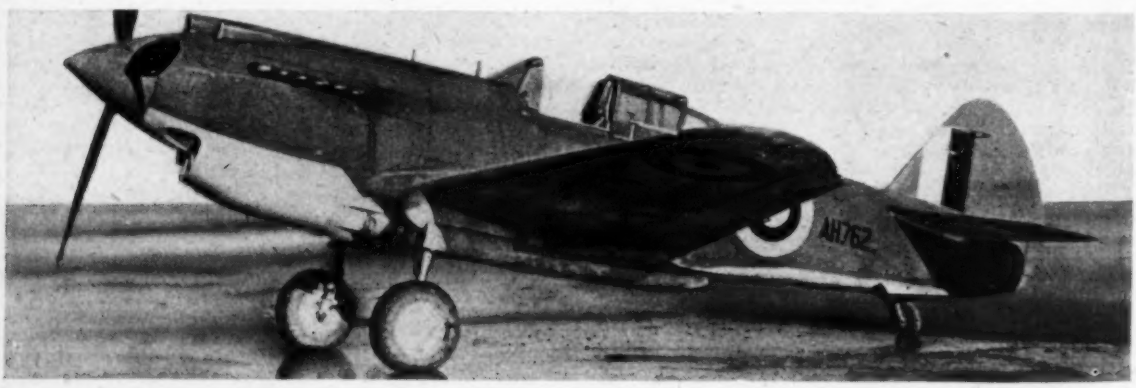


IN the United States of America there is a single-seater boasting the designation of Bell P-400 Airacobra (U.S. Army Air Corps P.39) 1,100 h.p. Allison V-1710-C37 engine. That same model standing on an R.A.F. aerodrome becomes a Bell Caribou with 1,100 h.p. Allison engine.

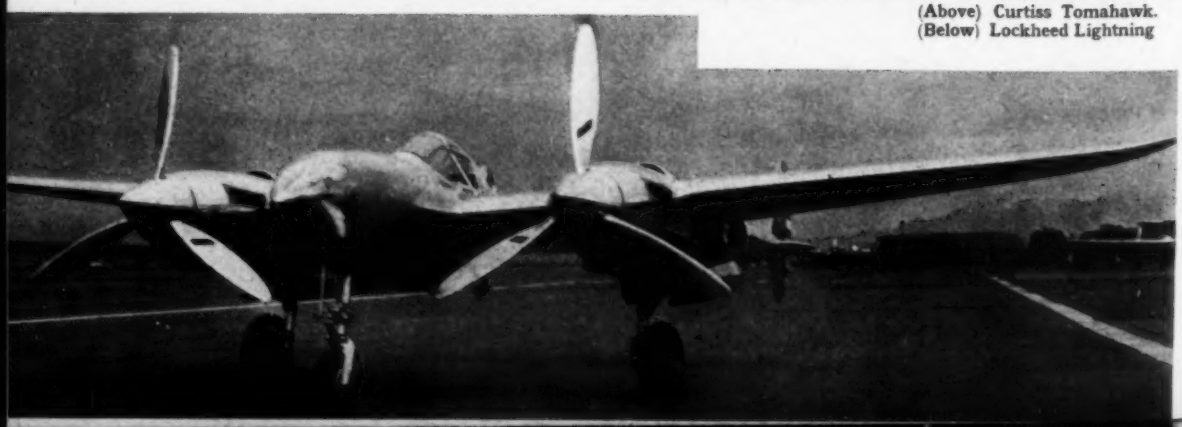
In order to give a clear picture of the American types that matter—devoid of all unnecessary catalogic erudition—they

SINGLE-SEATER FIGHTERS

Type	Span	Length	Height	Wing Area	Weight Empty	Weight Loaded	Engine	Top Speed	Range	Ceiling	Climb	Armament	Remarks
BELL CARIBOU.	ft. in. 34 0	ft. in. 29 9	ft. in. 9 3	sq. ft. 213	lb. 4,715	lb. 6,150	1,150 h.p. Allison (liquid cooled).	400 m.p.h. plus	2½ hr. cruising.	ft. 36,000	—	One 37 mm. shell-gun, two synch. m.gs., four wing m.gs.	Tricycle undercarriage. Engine behind pilot. Has been dived up to 620 m.p.h.
VULTEE VANGUARD	36 0	28 0	9 5	197	4,693	5,882	1,200 h.p. Pratt & Whitney Twin Wasp or 1,200-h.p. Wright Cyclone.	350 m.p.h.	1,150 m. cruising.	33,000	20,000ft. in 8 min.	Two sync. .3 m.gs. and .5 m.gs. in fuselage; three .3 m.gs. in each wing.	In production for R.A.F., but no name yet given.
CURTISS TOMAHAWK	37 4	28 11	10 8	236	5,500	6,914	1,100 h.p. Allison (liquid cooled).	360 at 16,000ft.	—	—	—	Two sync. .5 m.gs. and 4 rifle-calibre m.gs. in wings.	—
LOCKHEED LIGHTNING.	52 0	37 10	9 10	328	11,171	13,500	Two 1,100 h.p. Allisons (liquid cooled).	404 at 16,000ft.	1,000 m. cruising.	30,000	—	Two .5 and two .3 m.gs., one 23 mm. Madsen shell-gun. All in nose.	Original order was for 800. Tricycle undercarriage. Wing-loading—43.9 lb. sq. ft.



(Above) Curtiss Tomahawk.
(Below) Lockheed Lightning



(Above) Grumman Martlet. (Below) Curtiss Mohawk.

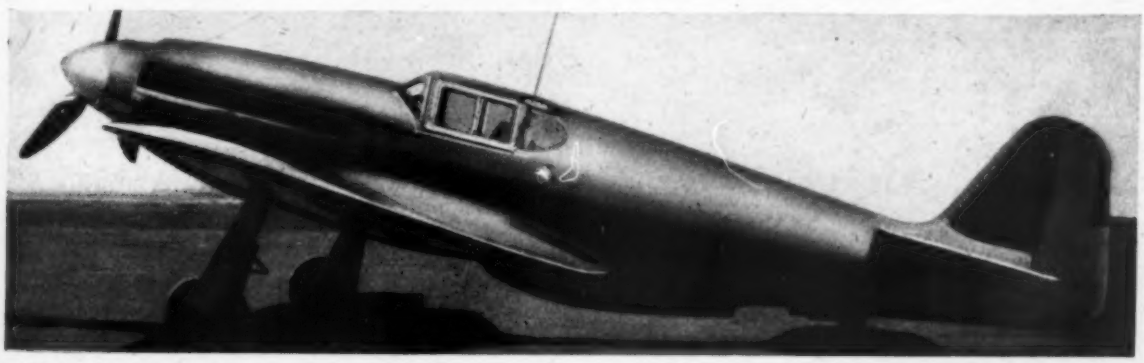
NAME

Data of the Renamed in the R.A.F.

appear in the following pages under their new names. The Vultee Vanguard, Boeing Flying Fortress, Douglas D.B.8A (Northrop A-17) and Consolidated 31 Flying Boat have not been given British names yet, but, since they are in service or on order for the R.A.F., they have been included. There are no particulars available for publication of the Curtiss Kittihawk, Vultee Vengeance or Martin Baltimore.

SINGLE-SEATER FIGHTERS

Type	Span	Length	Height	Wing Area	Weight Empty	Weight Loaded	Engine	Top Speed	Range	Climb	Ceiling	Armament	Remarks
GRUMMAN MARTLET.	ft. in. 38 0	ft. in. 28 5	ft. in. 11 10	sq. ft. 260	lb. 4,425	lb. 5,876	1,200 h.p. Wright Cyclone.	330 m.p.h. at 19,000ft.	miles 1,100	ft/min. 3,300	ft. 28,000	Two sync. m.gs. in fuselage and two m.gs. in each wing.	For use with the Fleet Air Arm.
CURTISS MOHAWK.	37 4	28 10	9 3	234	4,712	6,242	1,100 h.p. Pratt & Whitney Twin Wasp.	323 m.p.h. at 15,000ft.	650	—	33,000	Two .5 in. sync. m.gs. in top deck and four of rifle-calibre in wing.	—
NORTH AMERICAN MUSTANG.	37 0	32 3	8 8	236	5,990	7,708	—	400 m.p.h. plus.	—	—	—	Not released.	Radiator under fuselage, aft of cockpit.
BREWSTER BUFFALO.	35 0	26 0	12 0	209	—	—	1,200 h.p. Wright Cyclone.	330 m.p.h. at 15,000ft	—	—	—	Two .5 m.gs. in fuselage deck, two .303 m.gs. in wing.	Fleet fighter in the U.S.A. being used as land fighter in R.A.F.



(Above) North American Mustang. (Below) Brewster Buffalo.

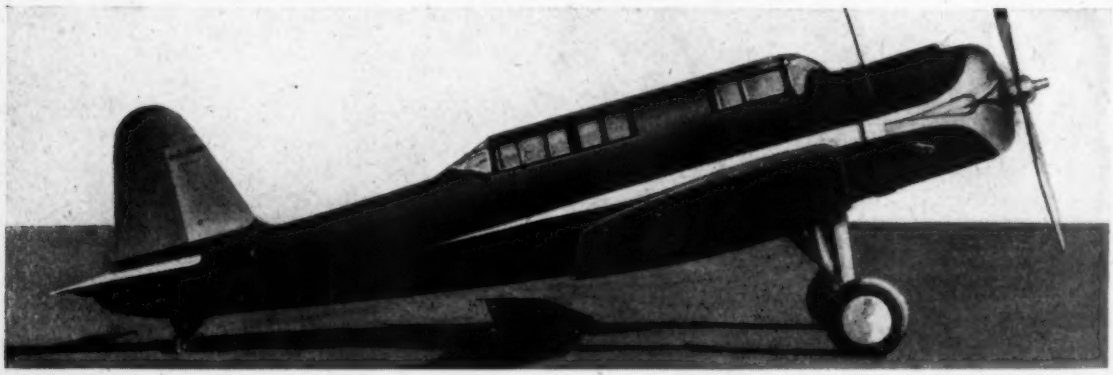
. . . BY ANY OTHER NAME (Continued)

(Left) The Douglas D.B. 8A.

(Below) The Brewster Bermuda.

TWO-SEATER DIVE BOMBERS

Type	Span	Length	Height	Wing Area	Weight Empty	Weight Loaded	Engine	Top Speed	Range	Ceiling	Climb	Armament	Remarks
DOUGLAS D.B. 8A.	ft. in. 47 10	ft. in. 32 5	ft. in. 9 9	sq. ft. 363	lb. 5,508	lb. 8,948	1,050 h.p. Pratt & Whitney Twin Wasp.	m.p.h. 260	miles 900 cruising.	ft. 29,600	ft/min. 1,430	Four .3in. m.gs. in wings. One or more free m.gs. in rear cockpit. Max. bomb load, 1,800 lb.	A development of the Northrop A.17, of which a number were handed over to the R.A.F. by the U.S. Army Air Corps.
BREWSTER BERMUDA.	39 0	27 9½	10 11	259	4,017	5,381	Wright Cyclone, 950 h.p.	302	776	30,000	2,220 at sea level.	One fixed m.g. firing forward. One free m.g. in rear-gunner's cockpit.	Box spar and leading-edge form watertight compartment for flotation.
VOUGHT-SIKORSKY CHESAPEAKE.	42 0	34 0	9 10	306	—	6,530	800 h.p. Pratt & Whitney Twin Wasp Junior.	255	700	28,000	1,500	Two rifle-calibre m.gs. (one fixed and one free).	—
CURTISS CLEVELAND.	34 0	27 7	10 5	317	4,456	6,000	1,000 h.p. Wright Cyclone.	249	730 cruising.	24,700	—	One sync. m.g. firing forward. One free m.g. aft. One 500 lb. or 1,100 lb. bomb beneath fuselage.	Extra fuel tank can be carried in place of bomb under fuselage.



(Above) The Vought-Sikorsky Chesapeake.

(Below) The Curtiss Cleveland.

. . . BY ANY OTHER NAME (Continued)

(Right) The Consolidated Catalina.

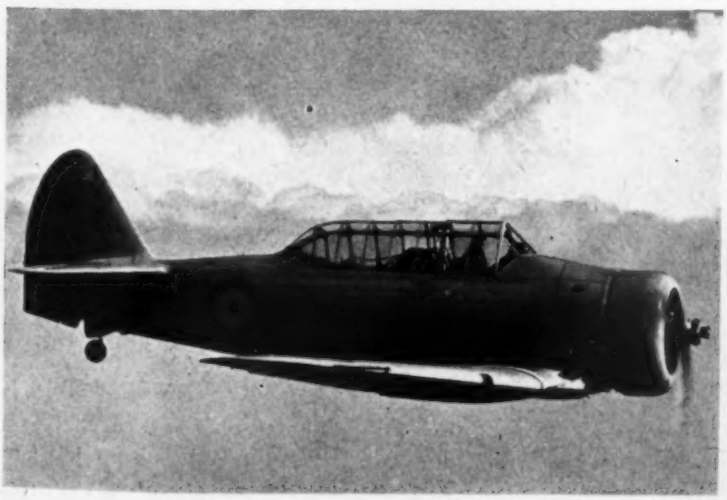
(Below) The Consolidated 31.

FLYING BOATS

Type	Span	Length	Height	Wing Area	Weight Empty	Weight Loaded	Engines	Top Speed	Range	Ceiling	Climb	Armament	Remarks
CONSOLIDATED CATALINA.	ft. in. 104 0	ft. in. 63 11	ft. in. 18 4	sq. ft. 1,400	lb. 14,250	lb. 27,000	Two 1,200 h.p. Pratt & Whitney Twin Wasps.	m.p.h. 199	miles 4,000	ft. 24,000	ft./min. 920	Gun turrets in nose and gun blisters in hull.	As a tricycle amphibian is in production for R.C.A.F. and R.A.A.F.
CONSOLIDATED 31.	110 0	73 0	22 0	1,050	28,000	50,000	Two 2,000 h.p. Wright Duplex Cyclones.	290 approx.	2,500 (with 11,000 lb. of bombs).	—	—	——	Wing-loading is exceptionally high at 48 lb./sq. ft.

TRAINERS

Type	Span	Length	Height	Wing Area	Weight Empty	Weight Loaded	Engine	Top Speed	Range	Ceiling	Climb	Remarks
NORTH AMERICAN HARVARD.	ft. in. 42 0	ft. in. 29 0	ft. in. 8 9	sq. ft. 254	lb. 3,958	lb. 5,200	550 h.p. Pratt & Whitney Wasp.	m.p.h. 206	miles 730	ft. 23,000	ft./min. 1,300	——
NORTH AMERICAN YALE.	41 0	28 5	8 10	246	3,247	4,375	420 h.p. Wright Whirlwind.	170	730	17,400	1,100	Undercarriage is not retractable.

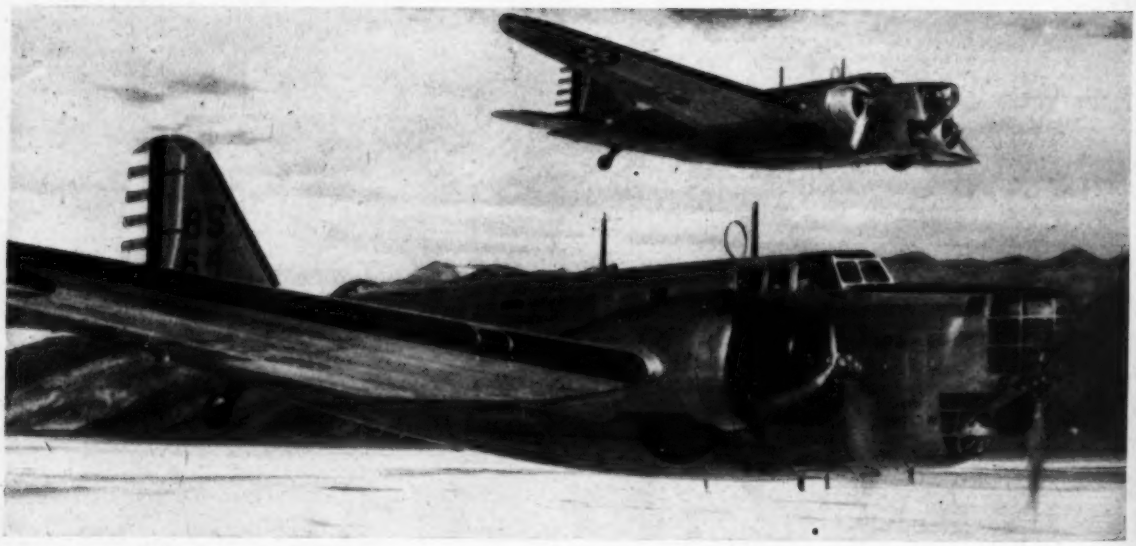


Two trainers (above) the Harvard and (right) the Yale.

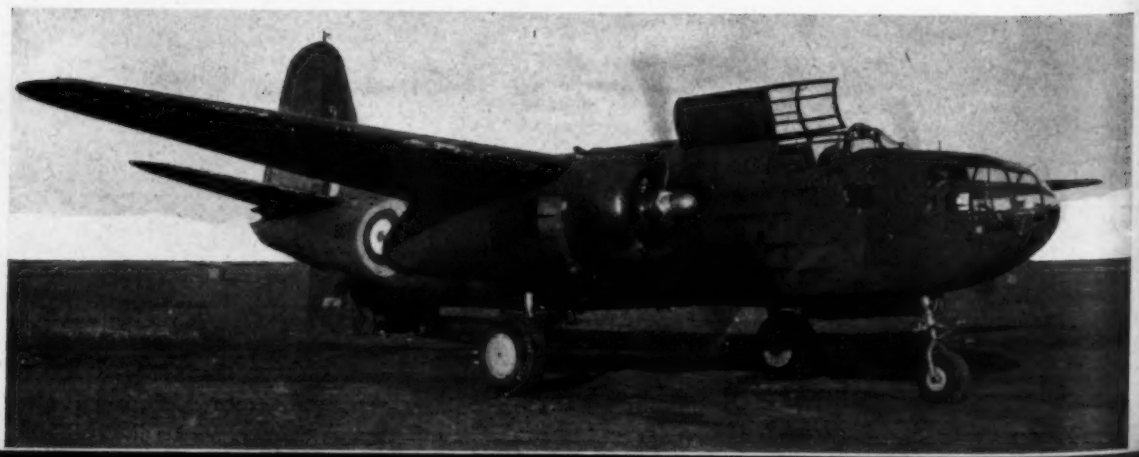
. . . BY ANY OTHER NAME (Continued)

(Left) Consolidated Liberator.

(Below) Martin Maryland.



(Above) The Douglas Digby and (below) the Douglas Boston.

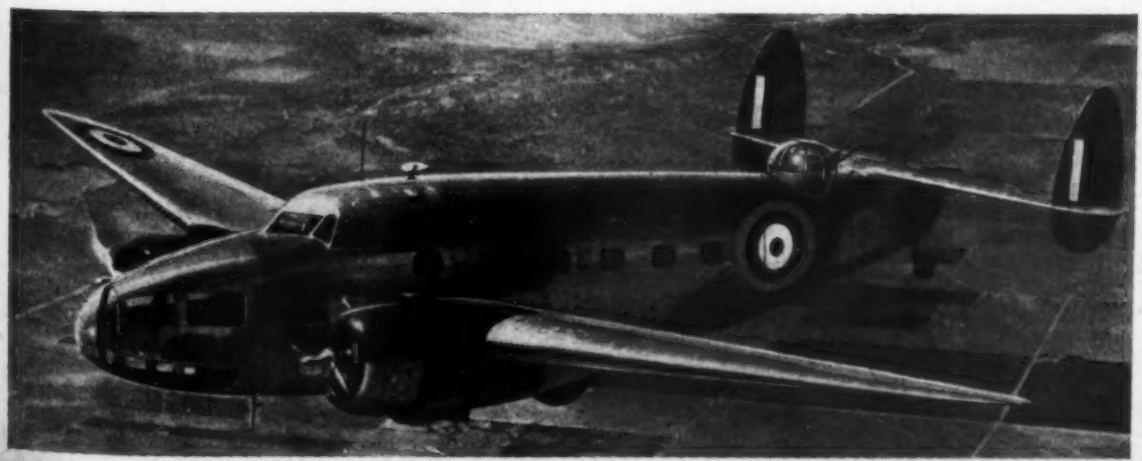


Boeing Flying Fortress

BOMBERS

Type	Span	Length	Height	Wing Area	Weight Empty	Weight Loaded	Engines	Top Speed	Range	Ceiling	Climb	Armament	Remarks
CONSOLIDATED LIBERATOR.	ft. in. 110 0	ft. in. 63 0	ft. in. 19 0	sq. ft. 1,100	lb. —	lb. 40,000	Four 1,200 h.p. Pratt & Whitney Twin Wasps.	m.p.h. 320	Miles 3,000	ft. 35,000	—	Gun turrets in nose, tail and various positions in fuselage.	Tricycle undercarriage. Crew of nine. Being delivered by air.
MARTIN MARYLAND.	61 4	46 8	9 7	539	10,586	15,297	Two 1,050 h.p. Pratt & Whitney Twin Wasps.	305	2,470	29,500	1,790 ft./min.	Four fixed m.gs. Two free m.gs. 1,250 lb. of bombs.	215 of these were ordered by the French.
DOUGLAS DIGBY.	90 0	57 0	15 0	—	—	29,500	Two 1,200 h.p. Wright Cyclones.	220	—	26,000	—	M.gs. in front turret and in retractable turret.	—
DOUGLAS BOSTON.	61 4	47 0	15 10	465	11 400	15,030	Two 1,050 h.p. Pratt & Whitney Twin Wasps or two 1,600 h.p. Wright Double-row Cyclones.	320 (Wasps) 370 (Cyclones.)	1,200 cruising.	—	—	Four fixed m.gs. in nose. Two free m.gs. in rear.	Tricycle undercarriage.
BOEING FLYING FORTRESS.	103 10	67 11	15 5	1,417	26,143	47,450	Four 1,200 h.p. Wright Cyclones.	268 at 14,000 ft.).	4,200	29,300	14,000 ft. in 9 min.	Five turrets and blisters in the nose and fuselage.	Being delivered by air across the Atlantic.
LOCKHEED HUDSON.	65 6	44 4	11 6	550	12,650	17,500	Two 1,100 h.p. Wright Cyclones.	260	2,000	25,000	—	Two fixed guns. Boulton Paul two-gun turret.	—
LOCKHEED VENTURA.	65 6	49 10	11 6	550	12,250	17,500	Two 1,200 h.p. Pratt & Whitney Twin Wasps.	280	1,700	27,000	1,800 ft./min.	—	All figures given are estimated from the "Lodestar."

(Above) Lockheed Hudson and (below) Ventura.



AIR-COOLED v. LIQUID-COOLED AIRCRAFT*

Their Drag, Weight, Cooling and Fuel Consumption : Three Groups of Aircraft Designed and Compared : Air-cooled Found Superior in All Three

By JOHN G. LEE
(United Aircraft Corporation)

THE author of this article is assistant director of research of the United Aircraft Corporation, which includes the Pratt and Whitney concern. He may thus be accused of being prejudiced in favour of the air-cooled engine. Nevertheless, the arguments put forward do not appear unfair, and the conclusions are distinctly interesting, to say the least. In England, too, research on cooling and cowling of air-cooled engines has not been standing still.

THERE are many reasons for choosing an air-cooled or a liquid-cooled power plant. They may be technical, economic, or practical. The present paper is confined to the technical reasons.

The presentation of a technical paper on this subject is made difficult at this time because of the restrictions which military necessity imposes upon the publication of new data. Those engineers who are engaged in military work and who have access to confidential material will agree, it is believed, that such material does not controvert the conclusions presented here.

Aerodynamics

The basic drag of a streamline object is first considered. In Fig. 1 the drag coefficient is shown plotted against fineness ratio for a variety of both new and old streamline shapes, ranging in form from nacelles to airship models. This curve serves as a reminder that, practically speaking, drag is not caused by frontal area alone, but is largely caused by skin friction. In a perfect fluid, a streamline object has no drag at all. Turning to Fig. 2, the skin friction drags of the streamline forms shown in Fig. 1 have been plotted. These skin-friction drags are presented as coefficients based on the *frontal* area of the streamline form, and are thus directly comparable with the total drag coefficients shown in Fig. 1. It is clear that when we increase the diameter of a fuselage to take a larger engine the increased drag is due, not to the increase of frontal area, but to the increase of surface area, other things being equal. The data shown in Figs. 1 and 2 have been used to determine fuselage drags in subsequent calculations—increased, of course, for the effects of roughness, scoops and other improprieties.

It is interesting to pursue the subject of frontal area and fineness ratio a little further. From Figs. 1 or 2 it can be demonstrated that the total drag of a fuselage 4.5ft. in diameter and 27ft. long (Fineness Ratio 6) is actually less than that of a fuselage 4.0ft. in diameter and 32ft. long (Fineness Ratio 8), even though the latter has 20 per cent. less frontal area. The short, fat fuselage is not as bad as one would like to think.

Of course, if the length of the fuselage or nacelle is already determined by other factors, increasing its diameter does increase its drag. This may be seen for two practical cases in Fig. 3. Here the drag, expressed as the familiar "f" factor, is plotted against cross-sectional area for a nacelle 15ft. long and a fuselage 30ft. long. The two vertical lines represent two extremes of area; that at the left is the minimum fuselage cross-section which will house a "jockey" pilot (ellipse 30in. × 48in.), and that at the right is the size which will accommodate a 2,000 h.p. P. & W. 2,800 air-cooled pursuit engine (circle 55in. diam.). The cross-section required to accommodate a practical liquid-cooled engine, in spite of our best efforts, lies much nearer the air-cooled engine than the "jockey" pilot. Even if we imagine a liquid-cooled engine so compact as to fit, with all its accessories, inside the cross-section required by a "jockey" pilot, the drag of the bare fuselage housing such an engine would still be at least 70 per cent. of the drag required for the present P. & W. 2,800 air-cooled engine.

Engine Nacelles

In the case of the drag of an engine nacelle the situation is complicated by the presence of the wing behind it. In Fig. 4 some unpublished nacelle tests are presented which were run in the 7½ft. tunnel at M.I.T. on a wing having a 36in. chord and 60in. span. The tests were confined to low-lift conditions, hence the low aspect ratio is not important. In Fig. 4 the minimum drag and minimum drag coefficient of each nacelle is tabulated, together with a sketch of the nacelle. Unfortunately, the drags of the extension shaft models may be somewhat in error, since they represent the small difference between the measurements of two relatively large quantities. The drags of the other models should be reasonably accurate. In Fig. 5 the minimum drag coefficients of the nacelles in Fig. 4 have been plotted against the ratio of nacelle diameter to wing thickness. A reasonable order prevails. The smaller the nacelle relative to the wing, the lower the drag coefficient. In subsequent calculations the more conservative values given by the dotted line have been used.

A word about the "submerged" engines may be in order at this point. During the past few years wings have been getting thinner for planes of a given gross weight,

* Paper presented before the Airplane Design Section of the Institute of the Aeronautical Sciences, New York, January 31, 1941.

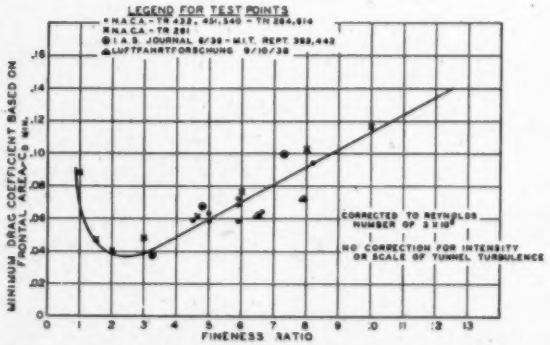

LEGEND FOR TEST POINTS
MINIMUM DRAG COEFFICIENT BASED ON FRONTAL AREA
FINENESS RATIO
CORRECTED TO REYNOLDS NUMBER OF
NO CORRECTION FOR INTENSITY OR SCALE OF TUNNEL TURBULENCE

Fig. 1. Variation of minimum drag coefficient with fuselage fineness ratio.

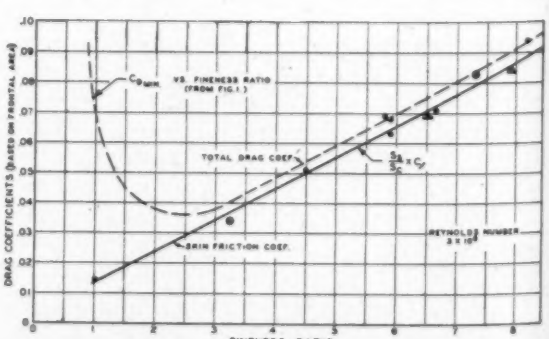


Fig. 2. Relationship between skin friction drag and total drag.

AIR-COOLED v. LIQUID-COOLED AIRCRAFT (Continued)

and it now seems almost impossible to design an engine which may be wholly housed within a wing and which will have sufficient power to be attractive. If the power of these "flat" engines is not really large, higher performance can be obtained in an airplane using larger engines of orthodox type. The tests in Fig. 4 show, however, that considerable improvement can be obtained by mounting "flat" engines horizontally in front of the wing, or by housing radial engines partially within the wing

Summarising the material presented so far, it is apparent that increasing the diameter of a fuselage or nacelle of given length results in an increase in drag, due principally to the increased skin friction area and to the interference effects upon the wing. This increase in drag is very much smaller than the increase in area, but is sufficient to count in favour of a compact liquid-cooled engine.

Cooling

Meredith* and others have shown that if air is admitted to a passage at high speed, expanded through a diffuser to a condition of low velocity and high pressure, and then heated, the heat energy imparted to it may be recovered as thrust, if the air is discharged rearwardly through a nozzle or gill. This is the familiar "ducted" radiator of the liquid-cooled engine. It is also the air-cooled engine itself. It makes no difference what the source of heat is, whether it be radiator, engine, or open flame, the same principles apply. To quote Meredith* specifically: "By correct design of low velocity cooling systems, in which the surface (whether in the form of a honeycomb radiator or of the fins on the cylinder heads and barrels) is exposed in an internal duct, the power expended on cooling does not increase with the speed of flight but . . . on the contrary, it should diminish to the vanishing point at a practicable speed, beyond which the cooling system contributes to the propulsion."

The only difference between the radiator and the air-cooled engine is that the radiator can be fitted with duct work without modification of the remainder of the cowl, and hence engineers found this a relatively simple change to make. It was made first. Meredith's principles have been recently applied to the air-cooled engine, and the problems appear not to be particularly difficult. As the speed of airplanes increases, the effectiveness of this method of energy recovery improves. The important point is not whether the air-cooled or the liquid-cooled engine has the lower cooling drag, but that the cooling drag of both is being rapidly reduced, and may ultimately become zero. This will occur when the heat energy recovered equals the duct loss.

Any system of heat energy recovery from the engine requires heat transfer from the engine, ultimately, to the cooling air. Heat transfer, to be efficient, requires that the heat be available at the highest possible temperature. Hence, the high temperature air-cooled cylinders are intrinsically more effective for heat energy recovery than the lower temperature coolant radiators. It should be noted also that only a minimum amount of cooling air should be wasted. This is where the "ducted" radiator has had an advantage in the past. The baffles of the air-cooled engine have not been good enough. Improvement in the internal cowling and baffling of air-cooled engines is under way.

In connection with the general problem of heat energy recovery, the smoke-flow photographs taken by Mr. Roger Griswold, II, and shown in Fig. 6, may be of interest. The flow shown in these pictures is two-dimensional outside of the model, but three-dimensional inside, with the direction of flow from top to bottom. Two conditions of flow around a typical engine nacelle are shown; that on the left represents the condition where no air is passing through the engine, and the flow around the exit gills produces a considerable suction. That on the right shows the same arrangement where air is admitted to the nacelle under

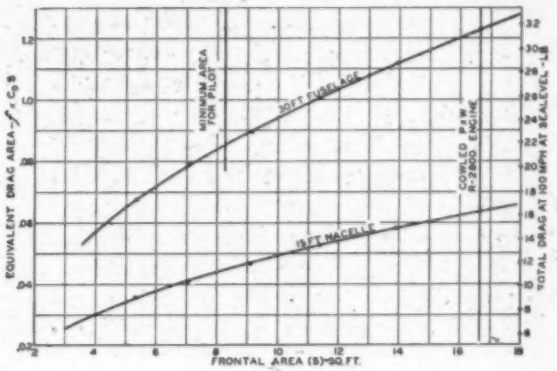

EQUIVALENT DRAG AREA = f = C_D S
MINIMUM AREA FOR PILOT
30FT FUSELAGE
COOLED P&W R-2800 ENGINE
18FT NACELLE
TOTAL DRAG AT 100 MPH AT SEALEVEL - LB
FRONTAL AREA (S)-SQ.FT.

Fig. 3. Drag of total nacelle and fuselage.

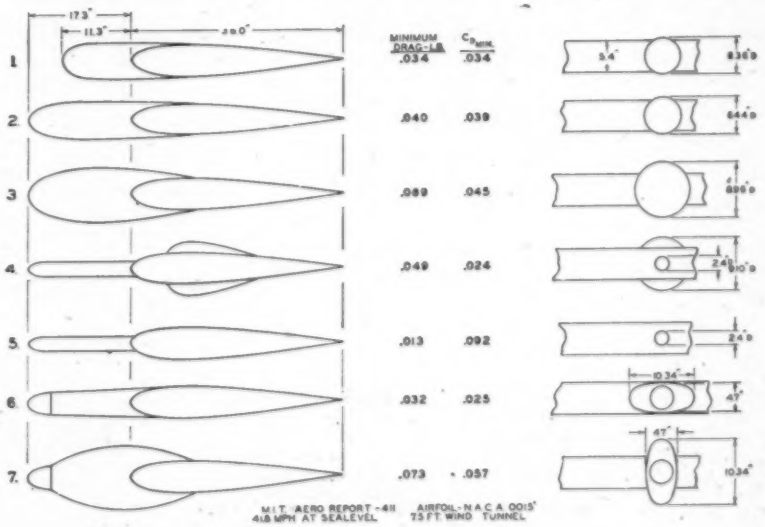
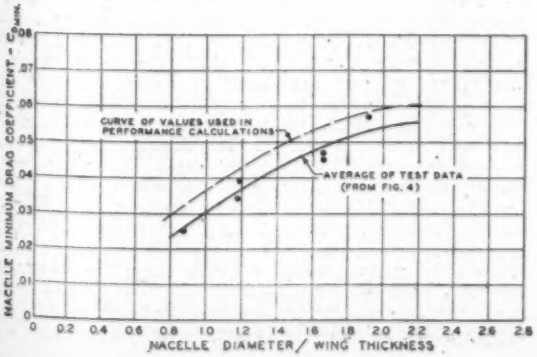


Fig. 4. Nacelle drag and drag coefficients (no cooling airflow — approximate Reynolds Number 3×10^6).

Fig. 5. (Below) Variation of nacelle drag coefficient with wing thickness.


NACELLE MINIMUM DRAG COEFFICIENT - $C_{D_{MIN.}}$
CURVE OF VALUES USED IN PERFORMANCE CALCULATIONS
AVERAGE OF TEST DATA (FROM FIG. 4)
NACELLE DIAMETER / WING THICKNESS

* F. W. Meredith: "Cooling of Aircraft Engines." R. & M. 1683, August, 1935.

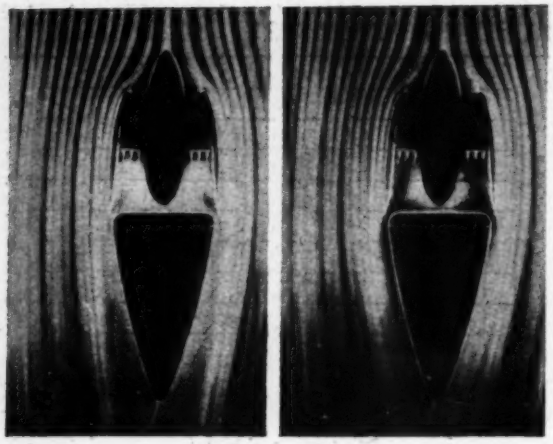


Fig. 6. Two types of flow. On the left, no air is passing through the engine. On the right, air is admitted under pressure.

pressure through the back wall of the tunnel and is allowed to flow out through the exit gills. Thus, the left-hand flow represents the limiting condition where the air stream is giving up energy to do work in sucking air through an engine, while the right-hand flow represents the condition where energy is supplied to the cooling air by means of heat or by a blower, or any other device, so that the air issuing from the exit gill has substantially the same velocity as the main stream. As might be expected, the left-hand flow results in a considerable disturbance, while the right-hand flow is smooth. The condition on the inside of the cowl differs in the two pictures; that on the left contains smoke, that on the right air. This fact has no significance in the comparison. Photographs of this sort cannot be used for any quantitative calculation, but they do indicate that as we learn to handle the flow of cooling air through an air-cooled engine, the power required to accomplish cooling will ultimately be reduced to a very small figure indeed, with no harmful effect on the external drag of the remainder of the airplane.

Another of Mr. Griswold's smoke-flow photographs in Fig. 7 shows the air entering the model more clearly than in Fig 6. Notice in particular how the streams approaching the model become wider, which indicates that they are slowing down. From this photograph it appears that the velocity of flow has been reduced about 50 per cent. before it enters the N.A.C.A. cowl. Thus, we have obtained a virtually perfect diffuser, without providing either space or weight. This model also was fitted with internal smoke jets to define the internal flow; it is not believed that these jets are of sufficient power to affect the external flow.

Throughout the remainder of this paper the cooling power for both air-cooled and liquid-cooled engines has been arbitrarily taken as 3 per cent. of the engine take-off rating. This value represents a conservative average from Pratt and Whitney two-row radials. The later engines have

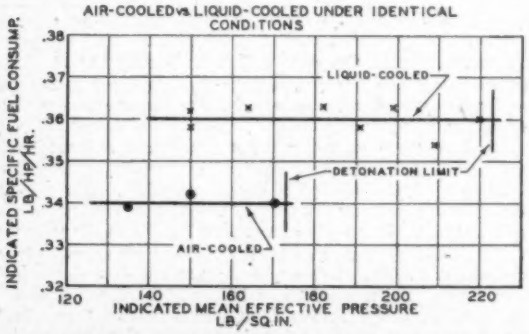


Fig. 8. Best economy fuel consumption tests (P and W 1830 single-cylinder engine).

AIR-COOLED v. LIQUID-COOLED AIRCRAFT (Continued)

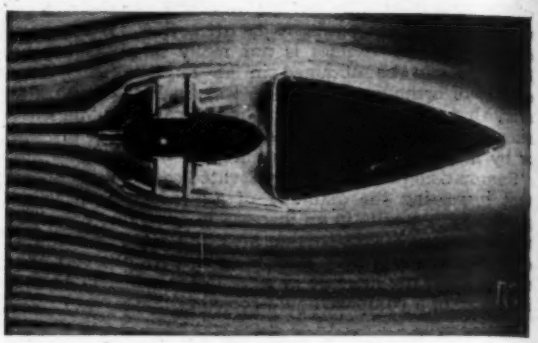


Fig. 7. The streams approaching the model become wider, indicating that they are slowing down. The velocity has been reduced about 50 per cent.

values of approximately 2 per cent. Furthermore, this assumption does not make use of Meredith's heat energy recovery, which, as has been shown, will reduce the cooling drag of both types.

Fuel Consumption

In any discussion of air-cooled and liquid-cooled engines, the question of the relative fuel consumption always comes up. It is recognised by all that the fuel consumption under full throttle conditions of the air-cooled engine is materially poorer than for the liquid-cooled engine. However, no engine, whether military or commercial, flies at wide open throttle for more than a very small fraction of its total time. Even the pursuit plane must spend the majority of its time looking for its enemy, or getting from its base to the probable scene of operations. The significant fuel consumption, then, is the cruising fuel consumption.

Much conflicting data has been presented on this subject. Since the compression ratio, supercharging, mechanical efficiency, and several other factors influence the fuel consumption, it is almost impossible to compare a group of liquid-cooled engines with a group of air-cooled engines and obtain any generalised result. In an attempt to eliminate these extraneous factors, Fig. 8 may be of interest. Fig. 8 shows the indicated specific fuel consumption of two single-cylinder engines run under identical conditions; in fact, they are really the same engine. In the lower curve the engine is air-cooled. In the upper curve the fins were machined off the cylinder, a liquid-cooled jacket substituted, and the same identical cylinder retested as a liquid-cooled engine. The tests were run at the same speed, valve setting, spark advance, and all other controllable conditions.

It is apparent that the air-cooled cylinder is definitely more economical than the liquid-cooled, irrespective of the mean effective pressure. Note that the fuel consumptions are based on indicated horse-power, that is, brake-horse-power plus friction-horse-power. If the fuel consumptions are divided by the mechanical efficiency of the engine, which may be of the order of 85 per cent., specific fuel consumptions will be obtained close to the usually quoted values. It may also be noted that these tests were run two years ago, and considerable improvement has since been made in the detonation limit of air-cooled engines.

It may be appropriate to remark that the United Aircraft Corporation has developed liquid-cooled experimental engines continuously over a considerable period of years. Consequently, it is justifiable to state that the data shown in Fig. 8, plus fuel consumption tests on a number of complete engines, both by United Aircraft and by others, lead inevitably to the conclusion that, under cruising conditions, the air-cooled engine is definitely more economical than the liquid-cooled. However, in making this study, the same fuel consumption figures have been used for both types, which is probably justified, since it will permit a

AIR-COOLED v. LIQUID-COOLED AIRCRAFT (Continued)

certain amount of wide open running, at which time the liquid-cooled engine has the better economy.

Weights

In studying the comparative weights of air-cooled and liquid-cooled installations, the actual weights of a considerable group of engines and their installations were investigated. This resulted in a mass of data, much of it confidential, but in all events too extensive to be presented in this paper. In addition, many of the units could not be assigned permanent weight values. The propeller size and weight, for instance, depends upon the speed and type of the machine, the engine gear ratio, etc. Consequently, the weight data have been summarised in Table I, giving the limits within which the unit weights were varied throughout this study.

Whenever possible, actual weight values were used. It will be seen that some of the weight values varied over rather wide limits. The liquid-cooled engine weights, for instance, have a range of about 15 per cent. This is because some engines included two-stage gear-driven superchargers

TABLE I

Comparison of Engine Installation Weights

	Air-cooled	Liquid-cooled
Engine Weight :		
Engine dry weight—lb./h.p.*	1.26 —1.35	1.10 —1.26
Engine power—h.p./cu. in.*	0.66 —0.75	0.70 —0.81
Power Plant Installation Weight :		
Propellers and controls	0.302—0.320	0.302—0.320
Starting system (less batteries)	0.020—0.045	0.020—0.045
Engine mount	0.045—0.080	0.045—0.080
Cowling	0.063—0.100	0.063—0.100
Oil system (inc. tanks)	0.040—0.060	0.040—0.060
Fuel system (less tanks)	0.020—0.040	0.020—0.040
Exhaust system	0.027—0.040	0.027—0.040
Radiators and coolant	— —	0.275—0.300
Miscellaneous**	0.015—0.040	0.015—0.040
Total normal P.P. Inst. Wt.—lb./h.p.	0.532—0.725	0.807—1.025
Additional Power Plant Installation Items :		
Intercoolers and ducts	0.090—0.095	0.090—0.095
Turbo-supercharger install.	0.109—0.132	0.109—0.132
Gearing, shafting—twin prop.***	0.344—0.354	0.344—0.354
Gearing, shafting—single prop.***	0.072—0.086	0.072—0.086

Notes :

* These values used when manufacturer's ratings were not available. Engine power is take-off rating.

** Includes diaphragms, carburettor air intake ducts, power plant controls, etc.

*** Twin-propeller installation is for tractor airplane with right angle drives. Single-propeller installation is for pusher airplane with extension shaft.

while others relied upon turbo installations. In all cases, the individual weights were picked with due consideration and with every effort to make them strictly comparable.

As an off-hand comparison between the weight of air-cooled and liquid-cooled installations, it is interesting to compare the average values from Table I. All figures are expressed in pounds per take-off horse-power rating. The average air-cooled engine weight is 1.31 lb./h.p. and its installation weight is 0.63 lb./h.p., making an average installed weight of 1.94 lb./h.p. The corresponding figures for the liquid-cooled engine are 1.18 lb./h.p. for the engine dry, and 0.91 lb./h.p. for the installation, making an average installed weight of 2.09. This is some 7.5 per cent. heavier than the air-cooled installation.

Comparison with Present Practice

The evidence presented thus far indicates that the cooling power and the fuel consumption of the air-cooled and liquid-cooled engines may be taken as substantially equal, but that the liquid-cooled installation has a certain advantage in drag and the air-cooled has a corresponding advantage in weight. It is not very satisfactory to try to evaluate the one advantage in terms of the other. For example, weight saved in the engine installation permits a weight saving in the structure; both savings permit a smaller airplane, which has less drag, and hence requires less fuel; this in turn permits another weight saving, and so on. The only practical method is to postulate a group of comparable airplanes, each designed from the ground up, in accordance with the proper area, the proper fuel load, etc. This is a tedious method, involving a considerable amount of "cut and-try," but it is the only method

TABLE II

Drag Coefficients of Conventional Modern Pursuit Airplanes

Airplane	Drag Coef.	Virtual Drag Coef.*
Air-cooled Pursuits		
A	.0196	.0213
B	.0230	.0258
C	.0216	.0239
D	.0224	.0210
E	.0173	.0164
Average Air-cooled values	—	.0217
Liquid-cooled Pursuits		
F	.0173	.0176
G	.0167	.0178
H	.0198	.0211
J	.0224	.0202
K	.0224	.0220
Average liquid-cooled values	—	.0197

* "Virtual drag coefficient" represents the normal drag coefficient adjusted to a common value of wing-loading of 27.0 lb./sq. ft.

which includes all the interacting factors, and is the method used in this study.

Before going on to this generalisation, it is advisable to check the values of weight, drag, etc., which have been presented, against actual present-day performance. This has been done for the pursuit type airplane. In Table II the drag coefficients of five conventional modern air-cooled pursuit planes and five conventional modern liquid-cooled pursuit planes have been tabulated. These figures have been obtained from flight test, and are "all-up" figures, including the drag of full military equipment and the thrust of exhaust jets, when present. The engine power was known, and only the propeller efficiency required estimation. For obvious military reasons it is impossible to identify these airplanes, or to quote the particular speeds and powers involved. Some are foreign and some domestic It is believed that the figures are reliable.

The drag figures are presented as coefficients based upon wing area, in the manner of recent N.A.C.A. reports. However, since the pursuits all had different wing loading, these coefficients are not strictly comparable. Airplanes with high wing-loading tend to show abnormally high drag coefficients. Accordingly, the speeds of all airplanes were corrected to a common wing-loading of 27.0 lb./sq. ft., the average of the group, and the drag coefficients were recalculated, based upon the new wing area and speed. These are the values quoted in Table II as "Virtual Drag Coefficients," and are strictly comparable, so that they can

TABLE III

Weight and Drag Analysis of Hypothetical Pursuit Airplanes

	Air-cooled	Liquid-cooled
Engine rated power, b.h.p. at 19,000ft.	1,250	1,150
Gross weight, lb.	7,000	7,000
Wing loading, lb./sq. ft.	27.0	27.0
Wing area, sq. ft. (1)	259	259
Tail area, sq. ft. (25% wing area)	65	65
Max. speed at 20,500ft., m.p.h.	363	364
Fixed weight, lb. (2)	1,500	1,500
Structural weight, lb. (8.0 lb./sq. ft.) (3)	2,070	2,070
Power plant installation weight, lb. (4)	810	1,090
Fuel and oil weight, lb. (.70 lb./h.p.) (5)	870	810
Engine bare weight, dry, lb. (6)	1,750	1,530
Gross weight, lb.	7,000	7,000
Power loading, lb./h.p.	5.6	6.1
Average drag coefficient, C_D	.0217	.0197
Equivalent drag area, $f = C_D S$, sq. ft.	5.62	5.10
Max. frontal area, includ. cockpit windshield, sq. ft.	16.3	12.8
Item :	**Equivalent drag area, f**	
Wing (C_D = .0090) + Tail (C_D = .0095) Including roughness, gaps, etc	2.330	2.330
	0.618	0.618
Fuselage (C_D = .095)	1.549	1.216
Miscellaneous	.760	.760
Inter-cooler	.175	—
Oil cooler	.025	.025
Cooling at 3%	.164	.149
Total drag area, f	5.62	5.10

(1) Aspect ratio 5.70.

(2) Fixed weight includes pilot, armour, 4 machine guns, ammunition, controls, radio, furnishings, and instruments.

(3) Structural weight includes wings, tail, fuselage, landing gear, and control system.

(4) Power plant installation weight .65 lb./h.p. for air-cooled and .95 lb./h.p. for liquid-cooled. Includes engine mount, inter-coolers, cowling, exhaust system, engine accessories, ducts, bullet-proof tankage, fuel and oil systems, and coolant and radiators on liquid-cooled type.

(5) Fuel and oil based on .040 lb./h.p.-hr. oil consumption and .50 lb./h.p.-hr. fuel consumption at 50% rated power for 2.6 hr.

(6) Engine bare weights based on typical two-stage air-cooled and two-speed liquid-cooled engines of 1.40 lb./h.p. and 1.33 lb./h.p. respectively.

AIR-COOLED v. LIQUID-COOLED AIRCRAFT (Continued)

be averaged. In making the speed corrections, only the wing chord was changed.

Starting with the average drag coefficients in Table II, an air-cooled and a liquid-cooled pursuit plane of conventional type were calculated, each weighing 7,000 lb., and each having a wing loading of 27.0 lb./sq. ft., which is the average loading for the planes in Table II. It was found that these average drag coefficients could be easily justified using the drag data presented early in this paper. Since the weight was fixed at 7,000 lb., the only "open" variable was the power of the engines. This was arrived at by "cut-and-try," making the proper adjustment for fuel weight, installation weight, etc. The propeller efficiency was estimated by the usual methods. The constants used in this comparison are shown in Table III. Study of this table shows that the drag, weight, and cooling data appear to be in accordance with the results of flight test.

The most interesting point in Table III is the resulting performance of the two airplanes. The speed of the air-cooled pursuit comes out 363 m.p.h.; that of the liquid-cooled, 364 m.p.h. Both airplanes are the same size and weight. Both have drags which are the average of current practice. However, the air-cooled engine comes out with 1,250 h.p. and the liquid-cooled with 1,150 h.p., both at an altitude of 20,500ft. The engine specific weights are taken from the nearest available pursuit engines. Fuel is provided to give each plane the same endurance.

One hesitates to argue from the specific case to the general, but here is an instance where the speed of the air-cooled and the liquid-cooled pursuits are substantially equal, both have the same wing loading, but the air-cooled has a materially lower power-loading (5.6 lb./h.p. air-cooled; 6.1 lb./h.p. liquid-cooled). Hence the take-off, climb, and ceiling, will all be materially in favour of the air-cooled. In short, the air-cooled is superior.

(*To be continued next week.*)

U.S. Aircraft Exports

IT is reported that the United States exported a total of 458 aircraft during the month of January and that the value of aeronautical exports reached a new record of $40,852,000 (£10,210,000).

A considerable proportion of these will be military aircraft for Britain; judging by the proportion for the later months of last year, about half. If so, the rise in exports to this country is slow but steady. The figures should be read in conjunction with those given on page 181, February 27th, which said that American production during January was 1,036, of which 957 went to the U.S. Army and Navy and British Purchasing Commission.

U.S.A. to Australia

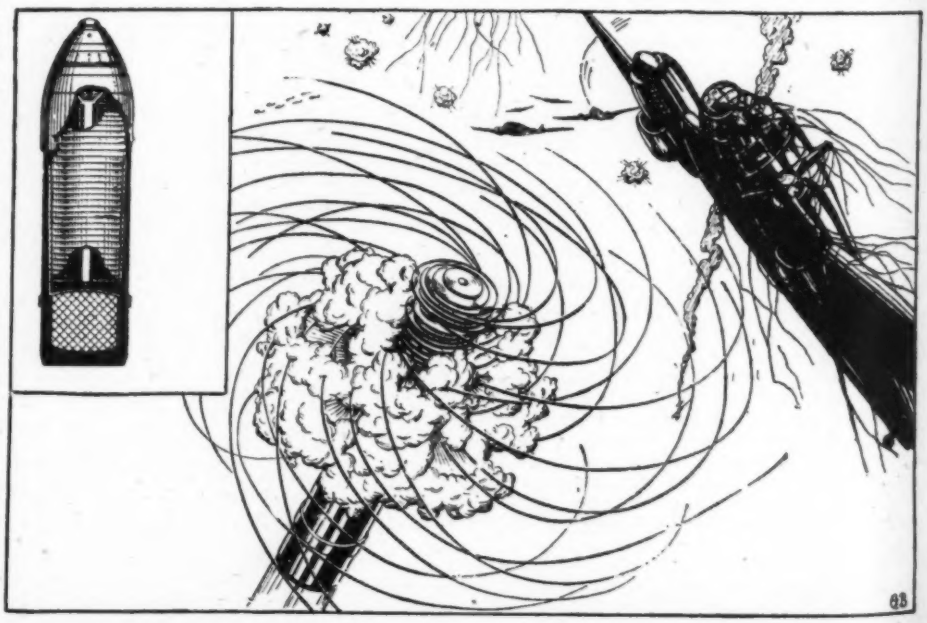
FOLLOWING the news that American bombers are being delivered by air across the Pacific for the defence of Singapore, comes word that the eighteen Consolidated PBY-5 flying boats which Australia has ordered for coastal reconnaissance will be flight-delivered also. Three Australians, whose names are known by many flying people and whose qualifications fit them admirably for this important job, have been selected to do the work. They are Captains L. J. Brain, "Scotty" Allan and P. G. Taylor. Brain and Allan have been associated with the flying boat work of Qantas Empire Airways and Taylor made the Pacific crossing in the single-engined Lockheed Altair with Kingsford Smith in 1934. Both Taylor and Allan flew in the original Australian National Airways with Kingsford Smith and Ulm, the original conquerors of this ocean. So the Pacific "trailblazing" by these men has not been valueless, as some people thought at the time it would be. Another great flight to Taylor's credit was with Rogers and Yancey when, in the Consolidated *Guba*, they crossed the Indian Ocean for the first (and only) time in 1939. This flight was made in four hops from Port Hedland, Western Australia, to Mombasa, with stops at the Cocos, Chagos and Seychelle Islands, a total distance of 5,560 miles.

Identification Charts

FLIGHT aircraft identification charts on cardboard, eyeletted and corded for hanging, have been entirely modernised and new types of aircraft introduced. The British chart includes six new types of aircraft, including newcomers from U.S.A. now in service. To the companion chart depicting German aircraft one or two new types have been added. Both charts are 22 × 14½in. and cost one shilling each, plus sixpence for postage.

A novelty is a transparent, pocket identification chart of German aircraft. This new chart comprises 18 semi-silhouettes and 41 line diagrams printed on two celluloid cards connected by a swivel eyelet. Produced in a handy size (approx. 4⅝ × 5⅝in.) and being waterproof, it will be invaluable ashore and afloat. Price one shilling and sixpence, post free.

All these charts can be obtained from the offices of *Flight*.



PERFIDIOUS ALBION

According to the Italian journal *Le Vie Dell' Aria*, this is our latest form of A.A. unpleasantness. Translation of their comment reads: "A new English weapon—this is a projectile containing a coil of steel wire(s). The projectile can attain a height of 19,700 ft., and its metal cables can 'unwind themselves' within a radius of 114ft."

Air Strategy—XLIV

THE MIDDLE EAST OFFENSIVE

Lessons of the Tactical Employment of Fighters and Bombers in the Present War—VII

By CAPTAIN NORMAN MACMILLAN, M.C., A.F.C.

IN no other area and to no other air force in the present war have the changes from peace to mobilisation, from mobilisation to war, and from defensive war to offensive war been so smooth as in the area of the Middle East, and to the Imperial air forces within that widespread area. Such conditions are ideal conditions for the competent organiser, and the results obtained and those still being obtained within the north-eastern sector of the African continent leave no doubts about the complete competence of the organisers of the British offensive there.

The Western Desert offensive was hailed as the perfect example of the supreme co-operation of the three Services in a combined action. The circumstances of terrain and of the disposition of the enemy forces made that strategic employment of Britain's and the Empire's power possible. Nor is it to be wondered at if for a period of years the details of such a campaign have been regarded with exceeding care by Britain's most skilful strategists in the Army. For if one man more than any other has called for the employment of all the skill of which British arms are—and have been for centuries—so manifestly capable within the arid tracts which lie about the peripheries of the wilder portions of the earth's surface, that man is Benito Mussolini. Inhabiting those tracts, he jibed at the British because they let him remain there in peace. In a way his personal debt is greater than Hitler's, for he has jeered at Britain's supposed decadence with all the untravelled foreigner's misunderstanding of British tolerance, and he has done it outside Europe.

Subsidiary Campaigns

The Imperial offensive in the Middle East is still in progress, and it is possible to examine only that part which has been completed. The attacks against Somaliland, Abyssinia and Eritrea must be looked upon as campaigns still in the making, and it is difficult to observe useful lessons from a campaign before it has been finished. In any case, these three campaigns are undoubtedly subsidiary to the main offensive, which was made against the Italian forces in the Western Desert. The latter forces were within (or should have been within) the power of reinforcement from the European continent. Indeed, it is, perhaps, yet too soon to say that they will not be so reinforced in Tripoli; but the garrisons of the farther east portions of the Italian possessions in Africa cannot be reinforced unless the British land forces are first defeated and the British naval forces in the Mediterranean subsequently outmanœuvred. Thus the present operations in Somaliland, Abyssinia and Eritrea are in a measure mopping-up operations following upon the true victory in the area between Sidi Barrani and Benghazi.

The importance of this operation is indicated by the manner in which it has drawn Hitler's armed forces south-eastward into the Balkans. Thus, if Hitler had to thank his partner Mussolini for his help in keeping a large force immobilised in the Mediterranean prior to the fall of France, we have, perhaps, to show also a measure of gratitude that Mussolini enabled us to pave the way to action.

Suppose Mussolini had not declared war on France and Britain on June 10th, 1940. What might not have happened? We could have had no victories in Africa to hearten the applauders of the Allied cause. We should have had no right of entry into any south European territory. We should have had to wait until Hitler was at the eastern end of the Mediterranean before a shot could have been fired there. And if that had come about it would have been a far more dangerous moment (to us) for Mussolini to declare war against us, for we should not then have been able to devote all we had in the Middle East and a good deal of what we had in the United Kingdom to the primary purpose of smashing up the Italian armies. Mussolini has been a good general for us; he has helped us quite a lot.

There is no doubt that we have won what we have by a quality of audaciousness. Whose was the driving brain behind the audacity has not been disclosed. It may have been no one man, but a happy combination of men at home and overseas who could plan and carry out the necessary moves to meet the ends they served.

Calendary Strategy

Perhaps it was the past fixity of Hitlerian strategy which made it possible to plan in this way. Hitler has always made his big strokes in the spring, his lesser strokes in the autumn. His winters have been quiescent. Probably that was because everywhere that Hitler struck was territory wherein winter was unsuitable for military operations—Austria, Czechoslovakia, Danzig, Memel, Poland, Norway, Holland, and so on . . . who could attack there with hope of success when the Continental, or northern, winter had a grip on the land? The Balkans faced Hitler with the same problem. (I've seen the Danube in the winter and I know what it can be like.) So the winter of 1940-1941 was, territorially, the same kind of winter for Hitler. Mussolini ought to have been wise enough with such a partner to avoid the attempt to browbeat Greece which led to his debacle in Albania at the very time of year when the winter was setting in in that inhospitable land of mountain and snow where the Grecian and Albanian frontiers meet. Just as Hitler has been adroit at selecting the best calendar moment for a major stroke, so Mussolini blundered over Greece.

History again has not recorded it, but the Italian ultimatum to Greece might have been intended as the Italian answer to our growing strength in the Middle East; for it is impossible to believe that the Italians could not have known that we were sending men and materials to reinforce our Middle East command. If the Italians had got the bases they demanded of Greece it would have made things easier for Graziani, more difficult for us. So, while Hitler was preparing for his winter hibernation, Mussolini plunged. That plunge, remember, delayed General Wavell's campaign. The reason for the delay has always been given by us as solely the necessity to replace the aircraft which had to be released from the Middle East to assist Greece. That explanation is good enough in wartime, but I doubt if it will stand the test of time; there is probably more behind the postponement of our Desert offensive than that, for clearly we did not send very great numbers of aircraft to Greece.

Now for some of the lessons to be drawn from the campaign in the Western Desert. I believe that it is necessary to admit from the beginning that the factors which made Mussolini take the action he did against

THE MIDDLE EAST OFFENSIVE (Continued)

Greece were, first, his need to strengthen his sea lines of communication across the Mediterranean, and, secondly, the ulterior objective of closing in towards the northern end of the Ægean Sea as a first move towards the inevitable attempt upon the part of Germany to circle the Black Sea in the eastward plunge for oil, Hitler's most vital commodity, as it is also Italy's.

To-day, the position is that Germany is faced with making the great attempt alone, for Italy's failure to get through to the Ægean forces Germany to alter her strategy and make a more westerly stroke than she might otherwise have had to make. The calculation must have been that Italy should take Thrace. Instead Italy took flight. The Hitlerian spring comes again, and with it the drums of war beat loud. Japan has entered from the other wing now that Italy has left the stage. And all this is, as near as no matter, the direct result of the tactical employment of aircraft in the Middle East.

Some people may say that is drawing too long a bow altogether and argue that the victory on the Western Desert was won by mechanised ground forces and infantry. And I agree, provided that it is first agreed that the initiation of the campaign was pendant upon the supremacy of the air. Else why wait for more aircraft before starting?

Co-ordinated Power

Which is the most important part of a hand barrow—the wheel which goes in front and takes the load off the ground, the container portion, or the handles by which it is lifted? It would take a Solomon to say; but I have seen more barrows disabled by a broken wheel than by any other part. And the wheel which went in front, and which took the load off the ground, in the Western Desert, was like the wheel which is spoken of in the first chapter of Ezekiel, when the prophet written of in that book was by the valley of the river of Chebar and dreamed a dream which was a vision of the future.

The campaign in the Western Desert was postulated upon a co-ordination of concentrated power which could be applied by a nation able to obtain local air and sea supremacy, and so provide the requisite conditions to enable a relatively small and highly mobile land force to hit far harder than it could have hit unaided. It is the place of no one but General Wavell to apportion the precise relationships of each of the extremely important auxiliary forces which enabled the ground units to break through the Italian fortified positions one after the other in a series of what we, in air parlance, would call half-rolls along the coastline of that sponge-fisher's paradise.

Nevertheless, it is pertinent to say that a force on land too inferior in strength would have been unable to bring to bear the weight of high explosive necessary to prepare the way for the final ground assaults, which in every case were reported as having been made with almost fabulously small losses. And in work of this nature we see the Navy and the Air Force in action in a way which must be the dream of the Staff College graduate. The Navy with its mobility and ability to carry its own magazine of shells; the Air Force with its capacity to strike far from its base and to do so quickly, so that the effort needed to get back and refuel and re-bomb seems trifling by comparison with the swiftest movement of the ground forces. In the course of the campaign we have seen the forward movement of ground forces referred to as phenomenal when they have been in the order of about fifty miles or so per day. It does not cut much ice with the fellow who is accustomed to thinking in terms of a cruising speed of 200 miles an hour as normal.

It is a great difficulty in life that all things are relative. And the relativity of the Western Desert campaign must have been the greatest problem which confronted the Staff responsible for the calculations of the movements of the tripartite forces engaged. And here precisely is where we come to the principal lesson of the Western Desert campaign.

The Limiting Factor

There is nothing in any part of the campaign to show that more was done than could have been calculated years ago in the Staff College, with the co-operation of the three Services faced with the new situation which had arisen as a result of the conquest of Abyssinia by the forces of the Duce. It would not have mattered very much whether the aircraft employed in the triple collaboration in the advance were monoplanes or biplanes, were very fast or very slow, so long as they were able to wrest the mastery of the air from the enemy who had to be engaged. For the essence of the whole operation was not concerned with the speed of aircraft but with the speed of the ground forces. Jolly old 504 Avros would have been all right if the I-ties had had nothing superior. As things panned out, the Italians were armed mostly with Fiat CR.42 fighters, and a few of the more modern monoplane type, which were not up to the Hurricane standard anyhow, with a number of bombers which were first-class in 1935 but have since been superseded in countries not owing allegiance to the "old black shirt," which is a far more deadly enemy than the "old school tie."

My critics will arise to slay me. They will say: "But there was never a more successful campaign, was there?" And I will answer: "Yes, a campaign which defeated an enemy entirely in one operation." Then will the critics say: "But the Italians were defeated in Cyrenacia." And again I will answer: "The Italians, like the Germans, must be defeated at home, and as the Chinese say: 'Allee same like the British.'"

And this brings me to what I consider to be the crux of the whole campaign in Libya. As it is, it is a local victory. A brilliant victory. A grand advertisement for the reinvigoration of John Bull. But it is not conclusive. Italy is still intact. Hitler is still making his moves. Our preponderant Air Force hitting power, expended upon desert objectives, has assisted German industry to work less impeded by bombs during the winter months. And, at the end, Italy, although no doubt grievously wounded, is not necessarily mortally stricken.

Could it have been otherwise? I believe it might. I believe that, simultaneously with the onslaught of our forces in the desert upon the trumpery (as they turned out) soldiers of Mussolini, we ought to have concentrated the remainder of our bomber force—all that we could spare from day-to-day operations—to engage upon the task of striking at Mussolini's metropolitan Italy and so to claw down the evil structure which he has built about the people of the land of whom Garibaldi spoke when he said cursed be the Italian who does not go to the help of Britain when she needs an ally. If we had gone for the main structure at the same time as the outhouses Mussolini might have been out of the war by now. Our tactical error was in not attacking metropolitan Italy simultaneously with the offensive in the Middle East.

Correspondence

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

STILL ROOM FOR GUNS?

Telescopic Wings

WITH reference to Mr. Manley's letter in *Flight* of February 6th, and also Mr. Goodall's of February 27th, regarding retractable wings, I should like to ask your indulgence in this matter for a short while.

I have held a provisional patent for some while for a laminated telescopic wing and I feel that it would revolutionise flying. Apart from the obvious advantages, when extended, of safer, shorter and slower taking-off and landing speeds (invaluable especially in Fleet Air Arm work) and also the great increase in flying speed when retracted, I believe it would prove of great help in countering the night-bomber. The fighter pilot has practically to depend upon sight to detect the enemy owing to the noise of his own engine, but with wings which could be considerably extended at will his engine could be cut off, the plane allowed to glide and the sense of hearing assist him in his problem of detecting other planes in the dark.

I am afraid I cannot agree with the comment which rules out such a great improvement solely because of the practice of using the wings for mounting accessories. The invention, as I should like to see it applied, would only use approximately a third of each wing, leaving plenty of room for armaments, etc., as before. F. R. J. NEWMAN.

[We are sorry to damp our correspondent's enthusiasm, but we have no faith whatever in the telescopic wing. The scheme was tried out thoroughly years ago by a Russian engineer, Makhonine, who had a monoplane built and tested in France. The wing worked according to plan, but its structure was heavy, and there was no equipment carried inside the wing. Mr. Newman's claim that only one-third of each wing need be affected must mean that only about one-sixth of the wing area telescopes, and that is too small a percentage to be worth while. Modern trailing edge flaps of various sorts give the desired lift increase in a much simpler manner.—ED.]

THE OBSERVER CORPS

How They Earn Their Pay

MEMBERS of the R.A.F. Observer Corps regret to find there are such people as "Observing Enquirer" who, after 18 months of war, have only just realised that at least some of their time should be given to the service of their country.

For many years before the war thousands of members of the Observer Corps gave up much of their spare time to perfect the special training and become efficient at quick and certain identification of aircraft. Each post at full strength consists of twenty-one members, and at the outbreak of war we were advised we were to receive the magnificent sum of 1s. 3d. an hour, and at the same time were issued with four fleece-lined coats, two oilskins and seven pairs of gum boots per post. No other clothing issue has yet been made. As most of our posts are in fields or on cliffs, drying facilities are not available, and in bad weather these garments become so sodden as to be useless. Each member therefore has to provide himself with warm and protective clothing. No rations of any sort are issued and no food allowance made.

To earn our 1s. 3d. we have to be out in exposed positions in all weathers throughout the day and night, and in London and elsewhere do not take cover when bombs are falling within a few yards of us, or shrapnel is pouring down. Many posts have been straddled with bombs on several occasions and some machine-gunned. For this we receive the large sum referred to, but which need not be accepted if one is in the fortunate position of not needing it.

Conversely, the Home Guard is a new body recently formed. Each member is given a uniform, greatcoat and full equipment. He is paid 3s. for ten hours and receives a meal allowance of 3s. for that period. Balancing the two, there is not much difference in the cost per man to the country.

Although the Air Ministry does not yet give us any official status we are delighted to find that our pilots and air crews consider that the assistance we are able to give them in various ways more than justifies our existence and are glad we had the foresight to train in peacetime so that, unlike "Observing Enquirer," we have been of some use in the first part of the war. For obvious reasons I must sign myself

DEPUTY HEAD OBSERVER.

[Our correspondent is mistaken in supposing that a member of the Home Guard receives 3s. for 10 hours' duty in addition to his 3s. subsistence allowance for that period, which would amount to 7.2d. per hour while on duty. Actually he receives 1s. 6d. if his duty period keeps him away from his home for not less than five hours and 3s. for a minimum of ten hours. This is a subsistence allowance (for meals he would otherwise have at home) but his actual services are unpaid.—ED.]

LONG-RANGE FIGHTERS

Fuel-tank-cum-bomb Suggested

I WAS extremely interested in the Editor's remarks on Captain Macmillan's article published in *Flight* of February 20th, 1941, and noted particularly the statement concerning two suggestions for extra petrol tanks in long-range fighters. The first suggestion, that of having external streamlined tanks, has already been adopted on some machines even though Henry Farman may have originated the idea. The second, jettisoning the tank after the fuel has been consumed, appears to have possibilities. If fighters have certain targets to attack beyond the range of 100 miles, as Captain Macmillan states in his article, there does not appear to be much point in flying even 100 miles just to attack with machine-guns, even if you have eight of them, as is the case with Hurricanes, Spitfires, etc.

Now, if an external tank were designed which had accommodation for both petrol and high explosive then the act of jettisoning the tank would not be so very extravagant after all. The amount of fuel which could be carried in such a tank would not be considerable, but would certainly enable the machine to reach its objective; it could then *bomb* the target and return on the normal fuel supply.

It will be seen that this suggestion includes the following advantages:

(1) The ability to reach the objective with ample fuel for returning.

(2) The ability to *bomb* the target; quite an advantage for most fighters.

(3) A definite return for the loss of each tank.

(4) A possible solution to Captain Macmillan's problem with, of course, some amendments!

I will not go into the question of the many disadvantages regarding this theory—it may have been considered in the past, though not to my knowledge—but I do think this bomb-cum-fuel-tank has possibilities.

With best wishes for the future of *Flight*.

E. C. FERGUSON.

F.A.A. AIR CREWS

Employer's "No" to a Volunteer

I NOTE in your edition of February 27th, 1941, that would-be members of F.A.A. air crews must volunteer at a Joint Recruiting Office; this includes men in reserved occupations. I registered for military service in February, 1940, and expressed a wish to serve in the F.A.A. air crew. I am in a reserved occupation, and my Chief refuses to let me volunteer. I cannot go against him, as I have my work to think of after the war. Since registering I have spent my spare time brushing up my maths., trig, etc., apparently to no purpose.

Why doesn't the Admiralty or Royal Air Force, as the case may be, call up all men who have expressed a preference for flying (irrespective of their occupations) and whose educational qualifications satisfy the requirements for air crew members? The employer would then be satisfied and the man's job assured for him at the end of the war.

"EAGER TO SERVE."

Service Aviation

DECORATED LINE O'BREASTS: Seven air gunners leaving Buckingham Palace after having received the D.F.M. from the King.

Middle East Honours

IN recognition of the excellent work of the R.A.F. in the recent battles in Libya, Somaliland and Greece, His Majesty the King has conferred the G.C.B. on Air Marshal Sir Arthur Longmore, K.C.B. D.S.O., Air Officer C.-in-C. Middle East, and the C.B. on Air Commodore Raymond Collishaw, D.S.O., O.B.E., D.S.C., D.F.C., who commands the Bomber Group in the Middle East.

Local Welsh Recruiting

ATTENTION is being paid to the need for smoothing the passage of men into the Royal Air Force, so that recruits may change from civilian to R.A.F. duties with the least loss of working time. Hitherto men from South Wales and the West of England who volunteered for ground duties in the R.A.F. have been obliged to travel long distances for interviews before enrolment.

This has now been changed. A centre has been opened at Penarth, Glamorgan, to which prospective recruits from South Wales and the Bristol area are sent for interview and attestation. As was explained recently in the House of Commons by Captain Balfour, Under Secretary of State for Air, this centre is to deal with recruits other than aircrew candidates and certain specialist tradesmen. It should result in a great saving of time and a gain in convenience to men from South Wales and the West who are anxious to enrol.

Hurricane House

AIR CHIEF MARSHAL LONGMORE recently opened an R.A.F. Rest House in Cairo where non-commissioned members of air crews can go for periods of rest after long spells of duty in the Desert. The hostel has been named Hurricane House and the usual rest period is one month.

Awards

THE KING has been graciously pleased to approve the following awards, which have been made in recognition of gallantry displayed in flying operations against the enemy:—

DISTINGUISHED FLYING CROSS.

P/O. J. H. ASHTON, R.A.F.V.R., No. 145 Squadron.—This officer has displayed great courage in his engagements against the enemy and has destroyed at least five of their aircraft. Four of these he shot down while serving with his squadron in France. His keenness for operations, under any conditions, has been an inspiration to his fellow pilots.

Flt. Lt. A. de V. LEACH, No. 224 Squadron.—In February, 1941, this officer, as captain of aircraft, carried out a reconnaissance patrol off the Norwegian Coast, under extremely adverse weather conditions and in the face of determined fighter opposition. Although severely wounded in the shoulder, when attacked by two Messerschmitts, Flt. Lt. Leach continued to engage the enemy and eventually drove them off. He had consistently carried out exceptionally fine work, pressing home his attacks on all occasions.

DISTINGUISHED FLYING MEDAL.

Sgt. W. S. AKEROYD, No. 30 Squadron.—In January, 1941, this airman was the rear gunner in one of a formation of aircraft detailed to attack an enemy camp. Approaching the target, the formation was attacked by six enemy fighters, and Sgt. Akeroyd was wounded in the finger. Later, he was hit in the right arm and finally in the stomach.

In spite of his injuries, he returned fire at every opportunity. His wireless set was smashed, and when the attackers had been driven off he crawled forward and informed the pilot of his injuries and the extent of the damage to the aircraft. He displayed great courage and fortitude throughout.

Sgt. O. WADDINGTON, R.A.F.V.R., No. 31 Squadron.—This airman was the navigator-bomb-aimer of an aircraft detailed to attack the aerodrome at Calathos one night in February, 1941. Extremely difficult weather conditions were encountered; nevertheless, Sgt. Waddington successfully navigated his aircraft to the objective.

In spite of intense anti-aircraft fire, the aerodrome was successfully attacked and two large fires were started. Valuable information was obtained regarding the aerodrome, and the number of aircraft there.

This airman has participated in numerous operational missions, and his outstanding skill and devotion to duty have contributed largely to the safe return of his aircraft in the most adverse weather.

Air Sgt. J. JACKSON, No. 40 Squadron South African Air Force.—This airman was the rear gunner of an aircraft detailed to carry out an offensive reconnaissance at Hobok one day in February, 1941. While assisting an armoured car which was being attacked by five enemy machine guns, the aircraft was severely damaged. Nevertheless, the pilot continued to fly at a low level, and Sgt. Jackson inflicted heavy losses on the enemy. He managed to distract the enemy fire until help arrived. This airman displayed great courage during the action.

CONSIDERATION: Air Commandant Her Grace the Duchess of Gloucester chatting with W.A.A.F.s in their recreation room during a visit to a Royal Air Force station in the south.

Royal Air Force and Fleet Air Arm News and Announcements

Roll of Honour

Air Ministry Casualty Communique No. 61

THE Air Ministry regrets to announce the following casualties on various dates. The next-of-kin have been informed.

KILLED IN ACTION (WHILE FLYING IN OPERATIONS AGAINST THE ENEMY).—Sgt. J. Butterworth, 747859; Sgt. D. A. Caldwell, 755498; Sgt. R. A. Chanin, 745943; Sgt. A. Chattaway, 740638; Sgt. S. A. V. Doe, 903109; Sgt. R. Ellis, 534399; F/O. W. E. Fruitiger, 72543; Sgt. R. A. Gapp, 701878; Sgt. J. E. Hill, 935567; Sgt. J. Munro, 638862; P/O. E. R. Phillips, 83293; F/O. F. S. Wilson, 76021.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—P/O. P. Arnold, 78736; Act. Sgt. J. D. Barber, 745841; Sgt. H. C. C. Bevan, 563098; P/O. L. M. Blanckensee, 41248; Sgt. C. F. Burt, 539698; F/O. J. A. Champness, 70124; P/O. B. A. Z. De Bressey, 79235; Sgt. F. J. Field, 535052; Sgt. C. D. Gavin, 580395; Sgt. J. Guest, D.F.M., 626540; Sgt. W. A. Hamlyn, 581386; Sgt. T. Hanlon, 755457; P/O. J. A. Heath-Brown, 42344; Flt. Sgt. R. H. Knott, 590277; P/O. D. A. Lea, 41432; P/O. P. C. Lindsey, 41036; Sgt. R. B. Lister, 754795; L.A/C. J. F. W. Mackrell, 751949; F/O. D. Murray, 41050; P/O. A. C. Ollerenshaw, 41729; Sgt. T. Robson, 939777; Sgt. N. S. Smith, 905353; Sgt. C. Stockman, 906289; Sgt. E. Taylor, 651358; Sgt. J. C. Threlfall, 746949; L.A/C. J. P. Toner, 610188; Sgt. E. Williams, 638749.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—A/C.2 J. C. Adams, 630069; P/O. C. C. R. Anderson, 40350; Sgt. M. R. Aslin, 516375; Wing Cdr. E. C. Barlow, 15181; Sgt. F. A. Beale, 741185; Wing Cdr. L. C. Bennett, 16216; Sgt. J. F. Borrows, 624811; Sgt. T. Boyd, 516716; Sgt. F. E. Buckland, 741093; A/C.1 R. V. H. Bulmer, 569834; Sqn. Ldr. G. J. Bush, 37061; Sgt. R. W. Butler, 520538; Sgt. A. N. Campion, 742698; Flt. Lt. E. G. F. Chivers, 39183; Sgt. E. Clarke, 580485; Sgt. R. D. E. Clarke, 580869; P/O. J. H. Coleman, 43692; Sgt. T. Conway, 535666; Act. Flt. Lt. N. G. Cooke, D.F.C., 37652; Sgt. J. Corney, D.F.M., 541684; Sgt. W. Cosgrove, 629330; Sgt. F. W. Davis, 745382; F/O. R. H. De Montmorency, 33185; A/C.2 J. Dolan, 902515; Sgt. G. H. Goldsmith, 526218; Sgt. H. Haggett, 626994; P/O. S. R. Henderson, D.F.C., 40826; Sgt. N. B. Herrict, 580956; F/O. T. P. K. Higgs, 36165; P/O. R. F. Hoskins, 43152; Sqn. Ldr. C. C. House, 32197; Sgt. A. J. Hughes, 653137; Sgt. H. G. Hughes, 580302; Sgt. R. W. James, 637282; F/O. A. J. O. Jeffrey, D.F.C., 39740; Sgt. J. Knight, 581515; Act. Cpl. A. Lippett,

SERVICE AVIATION (Continued)

D.F.M., 348039; Sgt. S. Longstaffe, 755125; P/O. J. Lynch, 43642; Sgt. J. B. McConnell, 580972; A/C.1 D. B. Mearns, 628503; A/C.2 M. B. Millar, 616790; P/O. J. H. Nicholson, 41052; P/O. E. I. Pearsons, 43370; A/C.1 W. Robinson, 633727; Act. Sqn. Ldr. E. G. Rogers, 37212; F/O. V. A. W. Rosewarne, 40021; Sgt. P. D. Salmon, 551589; Flt. Lt. J. S. Scott, 37484; F/O. Lord Shuttleworth, 70356; L.A/C. D. D. G. Spencer, 755611; L.A/C. G. C. Summer, 568173; Sgt. J. C. Usher, 580912; P/O. P. F. C. Villiers-Tuthill, 42165; Sgt. H. H. Wallis, 580532; Act. Flt. Lt. H. H. Way, 33402; A/C.1 E. Wilks, 537423; L.A/C. J. L. Williamson, 534498.

WOUNDED OR INJURED IN ACTION.—Act. Flt. Lt. H. R. Allen, 42582; Sgt. H. Blower, 970579; F/O. H. F. R. Bradbury, 39929; P/O. J. T. R. Chamberlain, 81677; Flt. Lt. J. F. F. Finnis, 40035; Sgt. R. Hill, 937296; F/O. R. W. G. Holdsworth, 74352; F/O. A. T. R. Hutchinson, 40039; Sgt. A. W. Jones, 638742; F/O. D. W. F. Landale, 70379; Flt. Lt. A. De V. Leach, 37107; Flt. Lt. J. A. F. Maclachlan, D.F.C., 39639; P/O. W. W. McConnell, 81643; Sqn. Ldr. A. W. D. Miller, 33171; P/O. G. E. Sharvell, 86422; Sgt. G. Targett, 755193; P/O. D. J. Thacker, 85273.

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—Flt. Lt. D. W. F. Barker, D.F.C., 70043; Sgt. W. H. Lowson, 754883.

MISSING, BELIEVED KILLED IN ACTION.—P/O. P. G. Blignaut, 84988; Sgt. A. J. Hollist, 759073; Sgt. H. R. Rundle, 529576; Flt. Lt. G. Watson, 7C716.

MISSING.—Sgt. B. L. Alpe, 621140; Sgt. A. J. Arnott, 639142; Sgt. G. W. F. Ashwin, 976524; Sgt. R. W. Baker, 754446; P/O. S. Baker, 80811; Sgt. L. Bird, 530075; Sgt. E. E. Blowfield, 564554; Sgt. W. A. Bracher, 745338; P/O. J. D. Chandler, 79518; Sgt. I. R. W. Clark, 977806; Sqn. Ldr. J. J. E. Coats, 37157; Sgt. E. Cottingham, 935544; Sgt. J. W. B. Craig, 751594; F/O. L. E. Cryderman, 41674; P/O. H. G. C. Day, 79746; Sgt. A. Douglas, 974493; P/O. K. A. G. Graham, 78737; P/O. R. C. Greenlees, 91106; Sgt. W. Haywood, 630520; P/O. C. H. Hedley, 84940; P/O. V. C. Keough, 81620; P/O. R. C. Lawson, 43006; P/O. F. J. Leslie, 82201; P/O. A. B. Loveridge, 85231; Sgt. A. I. G. McLean, 754363; Sgt. H. D. McNab, 628246; F/O. K. I. Mackenzie, 42140; P/O. M. A. G. Mason, 42417; P/O. P. R. Mildren, 42864; Sgt. T. M. Moore, 970973; P/O. C. P. Morris, 43108; P/O. H. L. Pattle, 82959; Sgt. J. H. Phillips, 742921; Sgt. J. F. J. Sheridan, 905697; Sgt. F. W. Smith, 759075; P/O. E. A. Tingey, 42450; Sgt. R. Trafford, 552655; A/C.2 H. J. Twinn, 650673; Sgt. J. Wallace, 638965; P/O. D. A. F. Warren, 78259; P/O. J. R. Waterman, 83731; Sgt. W. K. Winterbottom, 755883.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—P/O. A. H. C. Gibson, 82982; Sgt. H. B. McGregor, 745347.

KILLED ON ACTIVE SERVICE.—Sgt. B. T. Abbott, 903090; P/O. R. Atkinson, 43625; Act. Sgt. A. J. Bailey, 922432; P/O. B. G. Baring-Gould, 40441; Sgt. J. J. C. Batty, 525889; P/O. J. Buchanan, 79735; Sgt. V. L. L. Burnett, 903424; A/C.1 A. V. Chope, 845095; L.A/C. F. M. Cowie, 995867; P/O. E. J. Coleman, 42800; P/O. H. G. Craigmile, 87648; Sgt. A. Crooks, 636137; Sgt. R. E. Fenton, 646171; L.A/C. J. A. Fisher, 989156; A/C.1 L. Grew, 844945; Act. F/O. J. W. Harris, 83095; Sgt. V. C. Hill, 581454; A/C.2 D. W. Hughes, 987425; A/C.1 E. Hyde, 622952; Sgt. H. James, 943703; Sgt. W. L. Jones, 966020; L.A/C. H. Key, 633978; Act. Sqn. Ldr. P. C. Lawrence, 32228; P/O. E. Lunce, 89385; A/C.2 D. McBride, 654423; Sgt. R. Oates, 745949; A/C.2 E. Offord, 948296; P/O. D. C. Parker, 84981; L.A/C. G. W. Parnell, 1163982; Sgt. G. W. Poulton, 904204; Sgt. F. G. P. Shaw, 904873; Sgt. J. T. Silvester, 956162; Sgt. R. T. Tomlinson, D.F.M., 550950; Flt. Sgt. C. S. Townshend, 884509; F/O. D. Warburton, 74344; P/O. W. C. Watling, 44186; Sgt. R. F. Willis, 1003600.

PREVIOUSLY REPORTED MISSING BELIEVED KILLED ON ACTIVE SERVICE NOW PRESUMED KILLED ON ACTIVE SERVICE.—Cpl. F. H. Blake, 550631; P/O. E. H. Cross, 79088; Sgt. M. Field, 529040; Sgt. J. A. Malcolm, 581107; Sgt. D. Murrie, 751305; Act. Flt. Lt. J. W. B. Wilkinson-Bell, 70737.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Flt. Sgt. H. D. Alston, 370706; A/C.2 E. C. S. Applin, 906916; Sgt. W. Ardern, 581488; A/C.2 G. F. Ashard, 907022; L.A/C. G. W. Barrie, 547360; L.A/C. G. Bateman, 535546; A/C.2 C. V. Bellamy 947377; A/C.1 G. Blackett, 954766; L.A/C. F. J. Blackwell, 935698; A/C.2 K. V. Bott, 913271; A/C.2 D. Brown, 627081; A/C.2 G. O. Brown, 943513; A/C.2 J. Brunton, 946579; A/C.2 R. Burrows, 973456; Cpl. J. Cartwright, 610279; A/C.2 T. H. Childs, 906929; A/C.1 D. R. Clarke, 640028; L.A/C. S. Clarke, 518910; Cpl. C. Cook, 532979; A/C.1 J. W. Cooper, 633627; L.A/C. R. A. R. Cross, 900352; Cpl. H. Daniel, 568835; Sgt. T. F. Denton, 509566; A/C.2 G. A. Dignan, 619976; L.A/C. J. H. Dowding, 751081; L.A/C. H. Fisher, 551310; A/C.1 T. Fitzpatrick, 629004; A/C.2 C. Garside, 978500; A/C.1 P. Gavin, 637128; L.A/C. W. Gleave, 623072; Cpl. F. L. Gordon, 511338; A/C.2 W. J. Greenman, 977406; A/C.2 K. W. Griffin, 626117; A/C.1 G. E. Groves, 569713; L.A/C. H. P. F. Guymer, 624110; Sgt. S. Hamblett, 563152; A/C.1 W. Harpham, 623494; L.A/C. S. L. Harris, 751757; A/C.2 A. Hill, 903663; A/C.2 A. H. J. Hodgetts, 908944; L.A/C. F. D. C. Hoskins, 759330; A/C.1 V. H. How, 653766; L.A/C. L. Ingraham, 521686; L.A/C. C. P. Jones, 536553;

FROM TANK TO CORVETTE: Hotchkiss machine guns are used on Corvettes against dive-bombers. The feed and sight appear to be very similar to the type employed in our tanks in the 1914-18 war.

L./A.C. D. W. Jones, 533484; Cpl. T. D. Jones, 528052; Cpl. G. R. King, 564874; A/C.2 W. H. Kirk, 974666; L.A/C. G. A. Latter, 571314; A/C.2 H. Lunt, 909562; L.A/C. W. MacPherson, 642192; A/C.2 J. McFarlane, 975628; A/C.1 H. G. McLeod, 613055; L.A/C. N. McNaughton, 749340; A/C.2 W. W. Martin, 913127; Cpl. A. Park, 526717; A/C.2 H. V. Pearson, 947539; A/C.2 J. E. Peters, 900985; A/C.1 E. G. Plumb, 615972; A/C.1 W. Pugh, 542863; A/C.1 W. E. Radford, 618627; A/C.2 G. Reading, 908528; A/C.2 L. Redfern, 644120; A/C.2 E. C. Reeves, 642662; L.A/C. R. Riddell, 615860; Cpl. G. A. Rigby, 532890; A/C.1 H. Robinson, 625691; A/C.1 J. Rogers, 591650; Act. Cpl. J. Roxborough, 937857; A/C.2 G. Ruck, 907056; A/C.2 A. J. Scott-Kiddie, 628742; A/C.1 C. F. Slater, 631548; A/C.1 W. L. Small, 612896; A/C.2 F. H. Smith, 626102; Sgt. J. T. Smith, 563390; L.A/C. F. Stocker, 935588; Sgt. L. J Stokes, 740503; A/C.1 D. Stones, 629640; A/C.1 A. L. Symmonds, 628702; L.A/C. S. Taws, 614845; A/C.2 C. Timms, 573560; L.A/C. J. A. Waite, 524140; A/C.1 A. Watson, 620691; L.A/C. K. J. Whitmarsh, 742095; L.A/C. W. J. Williamson, 532511; A/C.1 F. J. Wilson, 636044; A/C.2 J. N. Wright, 908737; A/C.2 K. L. Wyatt, 640245.

PREVIOUSLY REPORTED MISSING BELIEVED KILLED ON ACTIVE SERVICE, NOW REPORTED KILLED ON ACTIVE SERVICE.—P/O. H. F. Hooker, 85920; A/C.1 W. M. Parry, 935584; F/O. D. M. Robertson, 70579.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Flt. Sgt. E. T. Baker, 327422; Sgt. F. Cartlidge, 639476; Sgt. J. E. Cheadle, 526263; Sgt. C. J. Day, 515690; Sgt. J. Gorman, 751753; Sgt. T. Jenkins, 506851; A/C.1 J. T. E. Peach, 840210; L.A/C. G. A. Pratt, 649631; Cpl. D. Price, 545993; F/O. G. Turner, 41499; Sgt. W. W. Walker, 903502; Sgt. W. C. P. Watkiss, 900359; Sgt. E. G. Williams, 531259.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—Sgt. N. C. Boyle, 903054; Sgt. E. F. Carter, 650974; A/C.2 A. Kent, 1350617; Sgt. T. Le Dong, 613302; A/C.2 A. L. Moore, 918875; F/O. S. Moxham, D.F.C., 40413; P/O. H. A. Nevett, 86701.

PREVIOUSLY REPORTED WOUNDED OR INJURED ON ACTIVE SERVICE, NOW REPORTED DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—Sgt. L. H. Phillips, 905311.

DIED ON ACTIVE SERVICE.—F/O. R. L. G. Ashworthy, 400659; Cpl. G. Birkutt, 520530; A/C.1 J. Cadman, 947994; W/O. J. Campbell, 337712; A/C.2 F. W. Cole, 1259937; Cpl. I. G. Davies, 938409; A/C.1 L. R. Davies, 906291; A/C.2 J. R. Fotheringham, 999044; P/O. D. D. Gray, 74109; A/C.2 N. A. Howartah, 1292336; P/O. P. W. Kerr, 89168; L.A/C. J. G. Lawrence, 636729; A/C.2 G. H. Lees, 1015482; A/C.2 R. Mabbott, 1173610; A/C.2 N. C. Maclean, 1365880; A/C.2 A. W. R. Mallett, 921945; A/C.1 A. Muir, 965758; L.A/A. L.H. Oliver, 577424; A/C.2 T. R. Pearson, 1074905; A/C.2 T. G. Purdy, 945632; L.A/C. A. W. Robinson, 701655; Sgt. P. Sharp, 156091; Wing Cdr. S. J. Smetham, 04217; A/C.2 H. Smith, 1359580; Cpl. W. J. T. Stevens, 949204; A/C.1 H. W. Tilson, 630477; P/O. F. K. Turner, 86180; A/C.2 J. Y. Varley, 1061417; Sgt. B. L. Young, 1266569.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—Sgt. R. Appleyard, 613211; F/O. R. D. Campbell, 41373; Cpl. W. Norris, 351799.

Royal Canadian Air Force

MISSING.—Sgt. J. A. Jepson, R53752.

Royal New Zealand Air Force

KILLED ON ACTIVE SERVICE.—P/O. B. I. Clausen, N.Z.40754; Sgt. W. L. Gosden, N.Z.39859.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—Sgt. T. N. Bassett, N.Z.401719.

Prisoners of War

NEXT of kin, if able to identify the men from the information published, are requested to advise the Casualty Branches of the Services concerned, forwarding Regimental or any other details.

The following is the latest list of British prisoners of war as received from enemy sources:—

In German Hands.

P/O. W. Davis, Mount Pleasant Road, Repton, near Derby.

F/O. A. H. Stratford, King's Bank, Beckley, near Rye, East Sussex.

P/O. F. A. B. Taff, Sunnyside, Morganforth, Budleigh, Cornwall.

Sgt. C. W. Tanner, Porthcowan, Cornwall.

London Gazette

Royal Air Force

Air Ministry,
Feb. 28, 1941.

General Duties Branch

Flt. Lt. (temp. Sqn. Ldr.) G. E. Horne is granted a permanent commn. in the substantive rank of Flt. Lt. (Feb. 21).

The follg. are granted commns. for the duration of hostilities as P/Os. on probn.:—Flight Sergeants: (Jan. 31) W. S. Munn; (Feb. 7) G. F. Roberts. Sergeants: (Feb. 2) J. Gilbert; (Feb. 5) F. Bavin-Smith.

P/O. on probn. B. A. James is confirmed in his appt. on May 1, 1940, and promoted to the war substantive rank of F/O. (Dec. 9, 1940).

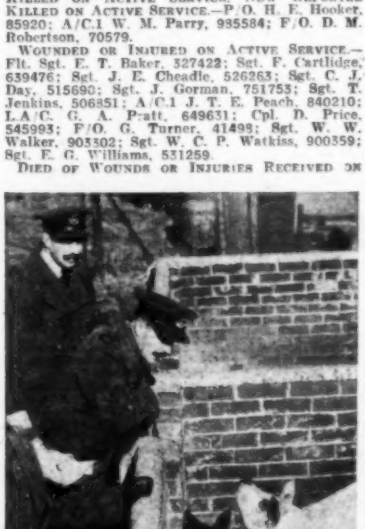
The follg. P/Os. on probn. are confirmed in their appts. and promoted to the war substantive rank of F/O.:—(Dec. 23, 1940) J. L. Bruzner-Randall, F. C. F. Stevenson, D.F.C.; (Jan. 17) A. Cross, R. Gatford, R. E. Wesson, A.F.M., C. S. West, A. Roman, J. L. Sharp, J. Wright.

The follg. F/Os. are promoted to the war substantive rank of Flt. Lt.:—(Sept. 3, 1940) R. M. Burns, B. W. Hayward, J. C. Milner; (Dec. 10, 1940) G. A. Brown; (Dec. 24, 1940) H. Burton, K. A. MacKay; (Dec. 31, 1940) P. F. Eames; (Jan. 30) R. A. Cruickshank, D.F.C.; (Feb. 10) R. H. Jacoby; (Feb. 12) F. T Knight; (Feb. 23) A. C. Peach.

The follg. P/Os. are promoted to the war substantive rank of F/O.:—(May 23, 1940) H. H. Taylor; (Sept. 3, 1940) P. W. Cook, A. W. Mungovan, J. F. McPhie; (Sept. 30, 1940) R. A. G. Willis; (Nov. 6, 1940) R. Hardy; (Dec. 9, 1940) W. H. C. Hunkin; (Dec. 27, 1940) J. M. V. Carpenter; (Jan. 13) J. K. Astin, A. Leeson; (Jan. 17) F. H. Denton, D.F.C., H. A. Outram, D. M. Rolph-Smith, R. C. E. Scott, E. V. Best, A. G. L. Humphreys, M. H. MacFarlane, J. E. S. Morton, C. A. Pownall; (Feb. 6) T. D. Welsh, D.F.C.; (Feb. 10) R. O. Day, A. J. J. Steel; (Feb. 18) P. E. Berry, D.F.C., N. E. Canton, J. H. D. Mercer, R. T. Stubbs.

The follg. P/Os are granted the war substantive rank of F/O.:—(Dec. 15, 1940) W. H. Wakefield; (Dec 24, 1940) C. A. T. Jones.

The follg. are transferred to the Technical Branch:—Wing Cdrs.: (April 24, 1940) R. J. M. de St. Leger, D. W. Clappen, J. F. Titmas, A. E. Case, A. J. Warwick, H. O. Jones, W. G. H. Ewing. Sqn. Ldrs.: (April 24, 1940) W. H. Husbands, W. S. Reed, W. H. Jinman, M.B.E., J. Kemper, M.B.E. (Ret.), W. Dickison, D.S.M., B. Samson, G. F. Alexander (since promoted), G. Farnhill (since promoted), N. C. S. Rutter, N. W. Wakelin, D. W. Williams, T. H. Moon, A. L. Holland, G. Silyn Roberts, A.F.C., P. G. Thomson. Flt. Lts.: (April 24, 1940) J. F. A. Day, A.F.C.



PERFECT SWINE: Officers of an Army Co-operation Squadron visit their pig farm.

SERVICE AVIATION (Continued)

(Ret.); (Aug. 14, 1940) A. K. Hunter. F/O.: (April 24, 1940) H. Z. Foreman.

P/O. on probn. K. S. Priestley is transferred to the Administrative and Special Duties Branch (Feb. 11).

F/O. J. G. Hughes takes rank and precedence as if his appt. as F/O. bore date Nov. 28, 1940. Reduction to take effect from Nov. 28, 1940.

The follg. P/Os. relinquish their temp. commns. on return to Army duty:—(Jan. 25) J. G. A. Ellis (Lt., Gloster R.); (Jan. 29) G. R. Ovens (Lt., R.E.), T. R. L. Waring (2nd Lt., R.E.).

Erratum

In notifn. of July 16, 1940, *for* Flt. Sgt. L. L. Kennedy *read* L. L. Kennedy Wilcox.

Technical Branch

The follg. are granted commns. for the duration of hostilities as F/O. on probn.:—Warrant Officer: (Jan. 25) H. W. Biggs. As P/Os. on probn.:—Warrant Officers: (Nov. 6, 1940) T. B. E. Roe (substituted for notifn. of Jan. 21); (Feb. 1) F .W. Wilkins. Flight Sergeants: (Feb. 1) C. W. Crimmin, A. C. McCreeth, J. L. O'Brien, W. R. Peake, A. G. Stanley. Sergeants: (Jan. 20) J. B. Stoneman; (Jan. 25) S. F. G. Hussey; (Jan. 27, sen. Aug. 9, 1940) W. Goodridge; (Feb. 1) A. Murray.

F/O. L. R. Ridley is granted the war substantive rank of Flt. Lt. (Dec. 12, 1940).

The follg. P/Os. on probn. are promoted to the war substantive rank of F/O. on probn.:—(Jan. 1) E. J. Irish, H. G. Reade; (Jan. 12) C. F. Bingham, E. Easton.

The follg. promotions are made with effect from the dates stated:—(Dec. 1, 1940) Wng. Cdr. to be Group Capt. (temp); A. J. Warwick. (Sept. 1, 1940) Sqn. Ldrs. to be Wing Cdrs. (temp.): T. H. Moon, G. Silyn-Roberts, A.F.C., P. G. Thomson; (Dec. 1, 1940) J. W. Hutchins.

Balloon Branch

P/O. on probn. D. G. Bayley is promoted to the war substantive rank of F./O. on probn. (Nov. 27, 1940).

Administrative and Special Duties Branch

The follg. P/Os. on probn. are promoted to the war substantive rank of F/O. on probn.:—(Sept. 26, 1940) H. J. Searle, M.B.E.; (Nov. 11, 1940) F. S. Lovell.

Equipment Branch

P/O. C. S. Reade is promoted to the war substantive rank of F/O. (Sept. 6, 1940).

Act. P/O. on probn. R. J. Jenkins is graded as P/O. on probn. (Nov. 13, 1940).

The notifn. of Jan. 14 concerning P/O. C. S. Reade is cancelled.

Accountant Branch

Flt. Sgt. D. J. Gould is granted a commn. for the duration of hostilities as P/O. on probn. (Jan. 28)

Act. P/O. on probn. J. L. Sefton is graded as P/O. on probn. (Nov. 21, 1940).

Medical Branch

Air Vice-Marshal H. E. Whittingham, C.B.E., M.B., Ch.B., F.R.C.P. (E.), F.R.F.P.S. (G.), F.R.C.P. (Lon.), D.P.H., D.T.M. & H., K.H.P., is appointed Director-General of Medical Services, Air Ministry, *vice* Air Marshal Sir V. Richardson, K.B.E., C.B., M.B., B.Ch., D.P.H., K.H.S. (March 1).

Flt. Lt. H. D. Conway, M.B., Ch.B., is granted a permanent commn. in the substantive rank of Flt. Lt. (Dec. 2, 1940).

Royal Air Force Reserve

RESERVE OF AIR FORCE OFFICERS

General Duties Branch

F/O. J. A. H. Sargeaunt is promoted to the war substantive rank of Flt. Lt. (Jan. 1).

Royal Air Force Volunteer Reserve

General Duties Branch

The follg. are granted commns. for the duration of hostilities as F/O.:—(Jan. 25) W. H. Elliott. As P/Os. on probn.:—(Feb. 3) J. Y. Childs, H. F. Mitchinson. Sergeants: (Jan. 25) H. D. Bedder; (Jan. 26) J. Stokoe; (Jan. 29) W. H. Hornby; (Jan. 31) R. R. Wright; (Feb. 2) D. N. Robinson; (Feb. 4) R. W. Coutts; (Feb. 8) A. W. Kearsey. Leading Aircraftmen: (May 23, 1940, sen. April 8, 1940) F. J. K. Mason (substituted for notifn. of July 2, 1940); (Nov. 17, 1940) R. G. Poulter, A. W. Rees; (Nov. 19, 1940) P. Montague-Bates; (Dec. 2, 1940) R. Bradwell, E. N. Bunting, J. H. Chase, T. F. Dorward, R. M. Graham, J. E. Moodie, D. W. Thompson; (Dec. 7, 1940) J. C. Brice, W. H. Hughes, G. R. Stead; (Dec. 21, 1940) F. P. Hill; (Dec. 28, 1940) D. N. Harper. (Jan. 4) P. L. Gauntlett, D. S. W. Lake, J. E. Ramshaw, A. J. Taylor; (Jan. 6) R. A. Hagger, J. E. Hall, L. H. A. Harper; (Jan. 12) S. E. Bulford, A. M. A. Majendie, H. P. Pagett, P. H. Shaw; (Jan. 12) M. D. Deloford; (Jan. 18) G. H. Cotton, H. I. Kitching; (Jan. 25) A. J. Carrington; (Jan. 29) E. E. Manison; (Feb. 1) A. D. Beaty, W. D. S. Bow, N. G. Henderson, R. J. Imber, M. S. Job, G. G. Lonsdale, F. H. Stephenson, M. L. M. Weber, M. Woodhouse, M. E. F. Baker, G. D. Lane, R. G. M. Morgan, J. B. Pertwee, B. B. H. Rodwell, E. A. W. Thompson, F. B. Thorpe, A. S. M. Pim, R. C. S. Renshaw, P. G. C. Wood. D. F. H. Biggane, W. P. Ferrie, I. B. Gunter, J. G. Brown, D. A. Bell, D. E. Walker.

The follg. P/Os. on probn. are confirmed in their appts. and promoted to the war substantive rank of F/O.:—(Nov. 27, 1940) L. P. R. Hockey; (Dec. 24, 1940) P. S. Hirst; (Jan. 1, sen. March 29, 1940) I. C. M. Sanderson; (Jan. 7) J. H. Willsher; (Jan. 14) G. B. Read, J. L. Spiller.

The follg. P/Os. on probn. are confirmed in their appts., Dec. 3, 1940, and promoted to the war substantive rank of F/O.:—(Jan. 15) I. Custerson; (Jan. 27) S. H. Palmer.

The follg. P/Os. on probn. are confirmed in their appts., Dec. 30, 1940, and promoted to the war substantive rank of F/O.:—(Feb. 4) J. C. Cowper, D.F.C.; (Feb. 7) C. T. Martin, M.M.

P/O. on probn. J. Atkinson is transferred to the Administrative and Special Duties Branch (Feb. 17).

Erratum

In notifn. of Sept. 20, 1940, concerning Cpl. A. J. Clegg. *For* Clegg *read* Glegg.

Technical Branch

Cpl. A. McW. Green is granted a commn. for the duration of hostilities as Act. P/O. on probn. (Feb. 2, sen. Nov. 12, 1940).

The follg. P/Os. on probn. are confirmed in their appts. and promoted to the war substantive rank of F/O.:—(Jan 9) G. J. Owen, H. W. Paterson; (Jan. 20) J. M. West; (Jan. 22) W. H. Foster; (Jan. 23) F. G. T. Dudgeon; (Jan. 29) H. Karslake.

Balloon Branch

The follg. are granted commns. for the duration of hostilities as P/Os. on probn.:—Corporals: (Sept. 26, 1940) G. J. Shannon; (Feb. 1) W. Caterer, E. J. Morris. Flight Sergeant: (Jan. 24) C. J. Griffin. Leading Aircraftman: (Feb. 6) R. W. Humphrey.

P/O. on probn. H. G. Lewis is confirmed in his appt., Nov. 23, 1940, and promoted to the war substantive rank of F/O. (Dec. 13, 1940).

The follg. P/Os. on probn. are confirmed in their appts. and promoted to the war substantive rank of F/O.:—(Sept. 20, 1940) H. H. Brooks; (Nov. 26, 1940) R. T. Lloyd; (Dec. 9, 1940) A. D. Forster.

Administrative and Special Duties Branch.

The follg. are granted commns. for the duration of hostilities as P/Os. on probn.:—(April 19, 1940) E. A. C. Bushell; (Sept. 26, 1940) E. C. R. Pullum; (Oct. 14, 1940) G. W. Mackay; (Oct. 18, 1940) R. E. Waugh; (Oct. 22, 1940) P. H. Faure; (Oct. 23, 1940) P. D. Bennett; (Nov. 2, 1940) H. S. Hodges, B. A. Westlake; (Nov. 4, 1940) J. W. W. L. Pendleton; (Nov. 7, 1940) H. E. Hayter, A. E. Kuring; (Nov. 8, 1940) D. G. K. Walker; (Nov. 12, 1940) R. J. R. Hartley; (Nov. 18, 1940) I. T. Stamp; (Nov. 22, 1940) J. A. Crook; (Dec. 1, 1940) G. Carr; (Dec. 8, 1940) A. W. B. Stewart; (Dec. 12, 1940) W. S. Abbott, R. F. P. Holloway, T. S. Robinson; (Dec. 13, 1940) F. E. H. Kemp; (Dec. 21, 1940) M. V. Stewart; (Dec. 27, 1940) F. Iversen, W. E. Goodyear; (Jan. 3) D. Munro, S. C. Surdivall; (Jan. 6) L. F. Blann; (Jan. 10) J. R. Willis, S. E. Bannister, R. W. Fowler, W. S. Hedley; (Jan. 11) D. M. Atkinson; (Jan. 14) K. J. Evans, A. M. Haigh; (Jan. 17) H. M. Crawford, F. R. Willis; (Jan. 20) D. C. Way; (Jan. 22) R. D. H. Martin; (Jan. 25) D. H. Banks, P. D. Childs; (Jan. 26) A. F. C. Parker; (Jan. 28) C. R. Bingham, J. S. Fairfax-Jones, C. S. Hill, J. R. S. Young; (Jan. 31) W. T. Barnicot, D. H. Bevan, E. G. Blackmore, F. A. Bradley, C. Carver, C. S. Chapman, F. Cheetham, D. S. Clark, J. Clement, M.C., A. T. Clough, E. J. Coltman, W. J. Corney, A. C. Davey, E. W. Davies, W. R. Dunstan-Crarey, D. S. Franz, H. R. Freeman, M. S. Geoghegan, W. P. Haines, F. Hill, R. M. Hood, E. Ingrams, H. C. F. Johnston, A. Jones, S. J. Knight, T. Lilley, J. S. Little, D. R. Lorimer-Thomas, J. R. Maris, H. R. Martindale, H. J. Mason, L. R. Mullen, J. G. Murdoch, C. H. Pendlebury, D. S. Reid, K. J. Roe, K. P. Stanworth, D. A. Taunt, W. W. Tunstall, A. Tweedy; (Feb. 1) F. W. Blank, W. H. Clarke, F. C. Curtis, J. G. Henderson, F. W. Humphries, H. S. Mumford, A. H. West, G. H. Woodhouse, G. de W. Young; (Feb. 3) V. W. Lindars, B. Morgan; (Feb. 10) R. H. G. Burridge, W. T. Collister, W. C. Davies, T. H. J. Field, G. R. Manning, T. A. J. Spencer; (Feb. 11) T. M. Fairclough, As Act. P/Os. on probn.:—Sergeant: (Jan. 31) S. W. Lawson. Leading Aircraftman: (Jan. 31) J. S. McArthur. Aircraftman 2nd Class: (Jan. 17) G. V. A. Seccombe-Hett.

The follg. P/Os. on probn. are confirmed in their appts. and promoted to the war substantive rank of F/O.:—(Sept. 9, 1940) H. C. G. Allen; (Jan. 8) J. M. D. Symons; (Jan. 13) I. A. Macdonald; (Jan. 16) B. B. Hick; (Jan. 23) R. W. Judge, E. H. M. Samson; (Jan. 26) D. B. Tullis, R. J. Debenham, D. A. Kingston, L. G. W. Mallows, E. G. Rhodes, B. L. Salmon, I. I. Simons, H. Thomas, J. R. Wearmouth; (Jan. 27) G. A. Woodward; (Jan. 3) E. O. Robertson.

The follg. P/Os. are promoted to the war substantive rank of F/O.:—(Sept. 26, 1940) A. G. Harrison; (Oct. 12, 1940) C. McC. Henderson.

The follg. P/Os. are granted the war substantive rank of F/O.:—(Oct. 3, 1940) E. P. Hardman, D.F.C.; (Dec. 1, 1940) W. G. Hicks; (Dec. 4, 1940) G. H. F. Knight; (Dec. 11, 1940) M. H. B. Jones; (Dec. 15, 1940) R. H. W. Richardson.

The follg. are transferred to the Technical Branch:—P/Os. on probn.: (April 24, 1940) H. J. Sweet; (June 28, 1940) A. H. E. Rogers; (Aug. 16, 1940) K. Fearnside, G. S. Wollatt; (Aug. 20, 1940) T. S. Smith; (Sept. 9, 1940) K. B. S. Wilder, R. C. M. Young; (Sept. 15, 1940) J. F. Fletcher; (Sept. 18, 1940) D. M. Wiggins (since promoted); (Oct. 1, 1940) F. H. Watts; (Nov. 11, 1940) H. Allen, W. C. Cooper.

Flt. Lt. G. Frankau relinquishes his commn. on account of ill-health (Feb. 19).

The commns. of the follg. P/Os. on probn. are terminated on cessation of duty:—(Jan. 14) J. W. Combe; (Feb. 7) J. L. Dale; (Feb. 10) J. F. R. Crighton.

The notifn. of Jan. 14 concerning P/O. H. Coverdale is cancelled.

Errata

In notifn. of Sept. 27, 1940, concerning P/O. J. C. E. Luard. *For* Sept. 13, 1940, *read* Sept. 18, 1940.

In notifn. of Jan. 28 concerning M. R. Mandviwalla. *For* Nov. 25, 1940. *read* Sept. 17, 1940.

Meteorological Branch

The follg. P/Os. on probn. are confirmed in their appts. Aug. 1, 1940, and promoted to the war substantive rank of F/O.:—(Nov. 26, 1940) C. Crichton-Miller (Nov. 27, 1940) D. H. Follett.

P/O. on probn. K. A. Hirst is confirmed in his appt. (Aug. 8, 1940) and promoted to the war substantive rank of F/O. (Jan. 15).

The follg. P/Os. on probn. are confirmed in their appts. (Oct. 3, 1940) and promoted to the war substantive rank of F/O. (Jan. 15):—H. J. Gummer, B. A. Sewell.

Equipment Branch.

The follg. are granted commns. for the duration of hostilities as Act. P/Os. on probn. (Jan. 31):—A. E. Bacon, L. V. Bailhache, R. L. F. Bailey, W. L. Bundey, R. A. Chalk, J. M. L. Crang, E. C. Daley, N. A. Doggart, W. E. Douglas-Osborn, V. C. Ganderton, F. N. Goodall, C. C. Hanrott, D. C. Henderson, J. Hinchcliffe, C. V. Howe, H. J. Hubble, T. B. Jaques, K. W. Jemmett, D. R. Lea, A. M. Lotery, A. J. D. Mackintosh, B. Milner, S. O. Osborne, W. E. Rigler, J. C. C. Sim, B. K. Snowden, T. H. Sykes, H. S. Tardrew, G. E. Terry, E. Wilson.

P/O. on probn. N. R. Lockwood is confirmed in his appt. (Nov. 9, 1940) and promoted to the war substantive rank of F/O. (Jan. 22).

P/O. on probn. A. W. Massey is confirmed in his appt. (Nov. 21, 1940) and promoted to the war substantive rank of F/O. (Jan. 31).

The follg. Act. P/Os. on probn. are graded as P/Os. on probn.:—(July 24, 1940) R. V. Coulson-Dunn (substituted for notifn. of Oct. 22, 1940) J. S. Poynder; (Nov. 13, 1940) C. H. Allen, D. R. Gelling.

P/O. G. H. Harris is granted the war substantive rank of F/O. (July 24, 1940).

Accountant Branch

P/O. on probn. W. J. Kerr is confirmed in his appt. (Oct. 9, 1940) and promoted to the war substantive rank of F/O. (Dec. 1, 1940).

The follg. P/Os. on probn. are confirmed in their appts. (Nov. 28, 1940) and promoted to the war substantive rank of F/O. (Jan. 22):—H. A. Adbury, C. A. Hill, P. J. Lea, A. S. Owen, G. C. Oxley-Sidey.

The follg. Act. P/Os. on probn. are graded as P/Os. on probn.:—(Sept. 4, 1940) C. G. A. Fripp; (Sept. 21, 1940) P. Evers-Swindell. C. Mont; (Nov. 2, 1940) T. W. Forrest; (Nov. 21, 1940) W. J. McLaughlin. J. A. W. T. Morgan, T. Wilson; (Dec. 26, 1940) L. D. E. Levie; (Jan. 6) R. Broadhead, W. F. Collicott, E. T. Dawson, J. Johnson, L. Jones, R. V. Palin, W. A. B. Pithie, W. G. Thompson, A. Waterfield, G. C. Wilson.

Medical Branch.

The follg. are granted commns. for the duration of hostilities as F/Os.:—(Jan. 28) C. C. Edwards, M.B., D.S., M.R.C.P., D.P.M., V. R. Gillis, M.B., B.S., J. T. Murray-Aynsley, M.R.C.S., L.R.C.P., J. G. Mathewson, M.R.C.S., L.R.C.P., J. C. Kitchin, M.B., Ch.B., M.R.C.S., L.R.C.P., E. H. Hudson, M.B., B.Ch., M.R.C.P., J. Hegginbotham, M.R.C.S., L.R.C.P., A. Redmond, M.B., B.Ch., W. E. C. Taylor, L.R.C.P. & S., L.R.F.P.S., C. W. Hutt, M.B., B.Chir., M.R.C.S., L.R.C.P., J. A. Ward, M.B., Ch.B., W. N. Riley, M.R.C.S., L.R.C.P., K. E. Guest, M.B., B.S., J. M. Gray, M.D., B.Ch., D.P.H., D. C. Caldwell, M.B., Ch.B., R. G. Mayall, M.R.C.S., L.R.C.P., D. V. Porter, M.B., Ch.B.

Flt. Lt. G. D. Dawson, M.B., Ch.B., relinquishes his commn. on account of ill-health (Feb. 21).

The follg. P/Os. are promoted to the war substantive rank of Flt. Lt.:—(Nov. 1, 1940) J. Apley, M.D., B.S., K. D. F. Morle, M.B., Ch.B., M. Stein, L.R.C.P. & S.; (Nov. 15, 1940) J. T. Burrowes, B.M., B.Ch.

Dental Branch

The follg. F/Os. are promoted to the war substantive rank of Flt. Lt.:—(Sept. 25, 1940) B. J. Beaton, L.D.S., R.C.S.; (Nov. 21, 1940) J. G. Pollock, L.D.S.; (Nov. 28, 1940) E. W. Mogg, L.D.S.; (Dec. 5, 1940) L. B. Somerville-Woodiwiss, L.D.S.; (Jan. 2) D. Rhys-Jones, L.D.S.

Chaplains Branch

The follg. are granted commns. for the duration of hostilities with the relative rank of Sqn. Ldr.:—(Jan. 1) The Rev. I. K. Jones, B.A.; (Feb. 1) The Rev. C. H. C. Lamb, The Rev. W. V. Scott, The Rev S. Thomas, B.A., The Rev. P. Anderson, The Rev. A. F. W. Kirby Marsh, The Rev. C. S. Kirkpatrick, The Rev. T. A. Goss, The Rev. J. F. Southworth, B.A., B.D.; (Feb. 4) The Rev. T. B. Robertson, M.A., B.D.

Auxiliary Air Force

Equipment Branch

P/O. L. G. Mobsby is transferred to the Administrative and Special Duties Branch (Sept. 16, 1940).

A.A.F. Reserve of Officers

General Duties Branch

F/O. R. P. Braun is promoted to the war substantive rank of Flt. Lt. (Feb. 3).

Women's Auxiliary Air Force

The follg. are apptd. Assist. S/Os.:—(Feb. 12) Cpl. R. B. Collier, Cpl. P. C. Craggs, Sgt. T. R. A. Dalby, Sgt. V. D. Dent, A/CW.1 N. K. Elwin, Cpl. K. M. L. Glennie, Cpl. I. M. B. Henderson-Palmer, Cpl. G. L. Ibbetson, Cpl. J. C. Lloyd-Carson, A/CW.1 D. W. E. Pountney, A/CW.2 J. L. E. Robinson, Cpl. K. S. Sharp, A/CW.2 A. C. Stewart, A/CW.1 E. F. Teece, Sen. Sgt. A. W. Wilson, A/CW.1 P. E. Vandepeer; (Feb. 15) A/CW.1 P. G. Clancy, A/CW.2 N. L. Cooper, A/CW.2 J. M. Crocker, A/CW.2 A. B. Crowder, A/CW.1 F. G. Fielding, A/CW.2 B. D. E. Haydon, A/CW.2 M. E. Jones, A/CW.2 E. F. Murray, A/CW.1 R. Nolan, A/CW.2 M. O'Sullivan, A/CW.1 C. J. Simpson, A/CW.2 P. D. Weatherstone-Smith.

The follg. Assist. S/Os. relinquish their appts.:—(Feb. 11) M. W. Simpson; (Feb. 13) A. D. Franks.